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# An Examination of the Leave No Trace Visitor Education Program in Two US National Park Service Units

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AN EXAMINATION OF THE LEAVE NO TRACE VISITOR EDUCATION  
PROGRAM IN TWO US NATIONAL PARK SERVICE UNITS

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A Dissertation  
Presented to  
the Graduate School of  
Clemson University

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In Partial Fulfillment  
of the Requirements for the Degree  
Doctor of Philosophy  
Parks, Recreation, and Tourism Management

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by  
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August 2009

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## ABSTRACT

The purpose of this dissertation was to examine overnight National Park Service (NPS) backcountry visitors' behavioral intentions to comply with promoted LNT principles as well as their opinions regarding the efficacy of various LNT education delivery strategies. Leave No Trace is the most pervasive outdoor skills and ethics training program addressing human powered recreationists in existence however, empirical investigations into the efficacy and diffusion of the program have been scant to nonexistent.

The study sample was obtained by intercepting visitors at backcountry permit issuing stations in Glacier National Park (GNP) in northwest Montana and Olympic National Park (ONP) in northwest Washington during the summer 2007. Primary study data were collected following a modified Dillman (2007) procedure using mail-back self-administered questionnaire with multiple contacts to increase the response rate. 836 valid addresses were collected and 593 questionnaires were returned providing an overall response rate of 70.9%.

The first manuscript discusses the conceptual foundation, development, cross-validation, and psychometric qualities of the Backcountry Visitor Ethics Scale – Version 1 (BCVES-V1), a research instrument designed to measure attitudinal conformity with the LNT principles for responsible recreation. The resulting measurement model, a second-order three-construct 15-item scale, exhibited satisfactory fit properties across both samples and is largely consistent with the conceptual framework used to develop the

measure. The second manuscript utilized an extended version of the Theory of Planned Behavior (TPB) to gauge the theory's effectiveness in predicting behavioral intentions to comply with LNT principles. The resultant model explained as much as 44.3% of the variance in intentions to comply with promoted practices; however, significant predictors of intentions vary by unit. The third manuscript discusses the diffusion and perceived effectiveness of the LNT visitor education program through the lens of Rogers Diffusion of Innovations Theory (Rogers, 2003). Results indicate the vast majority of respondents were aware and supportive of the LNT program, and highlight the role of both family-friends as well as the NPS for diffusing the LNT message amongst recreationists. T-test analyses indicate marginal effectiveness of four primary dissemination strategies on self-reported knowledge of LNT principles; however, effectiveness varies widely by unit.

## DEDICATION

To Jenna, Charlie, Abbey, and to our yet to be named little bean. I love you all more than you know.

## ACKNOWLEDGEMENTS

As with almost any adventure in life, the document you are holding would not have been possible without the support of numerous individuals. Heartfelt thanks to my advisor, chair, kayaking partner, and friend, Dr. Bob Powell. Bob, without your help, not only would the dissertation likely not have happened but the degree as well. Brett, thank you for believing in me and in my ability to carrying out the project. Fran, thank you for reminding me that my research must first be of benefit to those on the ‘front lines’ of protected area management. Bill, thank you for your insight and friendship over the past four years. And thank you DeWayne. Without your courses, guidance, and assistance throughout my time at Clemson, this dissertation and manuscripts contained within would be of far lesser form.

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The PRTM Department at Clemson University must be acknowledged for support and assistance throughout my four years as a student. Many thanks to Karin Emmons provided technical support and assistance throughout the duration of the study. Finally, thanks to the 593 NPS overnight visitors who completed and mailed back a questionnaire.

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## CHAPTER ONE

### INTRODUCTION

#### Background & Introductory Information

Americans enjoy participating in nature-based outdoor recreational activities. Current estimates purport that three-fourths of the US population, 225 million people, participate in at least one outdoor recreation activity annually (Southwick & Bergstrom, 2006). Americans are estimated to own 16 million boats, two million all terrain vehicles, and an estimated 40 million participate in freshwater fishing (Vale, 2005). Many Americans enjoy recreating within the boundaries of our national parks and forests. As discussed by Marion and Reid (2001), use of US National Forests increased from 4.6 million visits in 1924 to over 900 million in 1999. The story is similar for the National Park Service (NPS) where visitation escalated from an estimated 33 million recreation visits in 1950 to approximately 278 million recreation visits in 1999. Today the NPS hosts, on average, 275 million visitors annually.

Many benefits result from these high rates of participation. Outdoor recreation is a important contributor to the national economy, contributing an estimated \$730 billion dollars annually (Southwick & Bergstrom, 2006). From a social perspective, outdoor recreation provides individuals an escape, higher quality of life, the chance to socialize with family and friends, and the opportunity to connect with nature (Mannell & Kleiber, 1997).

There is, however, a negative side to outdoor recreation. Increases in visitation to forests and protected areas can result in crowding, conflict between users, and potentially the degradation of resource conditions (Manning, 1999). Wilderness and backcountry areas, those federal lands that are managed under the most stringent of guidelines, have not been immune to increases in visitation rates and potentially negative consequences of visitation. It is now acknowledged that certain wilderness and/or backcountry areas are being significantly impacted, and the increases in environmental degradation is correlated with the rising popularity and use of such areas by recreationists. Recreation ecologists have demonstrated how even modest use can cause significant impacts to the landscape (Hammitt & Cole, 1998; Leung & Marion, 2000). The equation is simplistic yet indubitable: *Increased Use + Lack of Compliance with Recommended Practices = Degradation of the Resource*. The magnitude of this problem has prompted scientists at the interagency Aldo Leopold Wilderness Research Institute to put forward that, “understanding, managing, and restoring recreation impacts” is a top research priority (Cole, 1998, p. 3).

To help mitigate negative impacts, natural resource managers typically employ a two-pronged strategy: education and/or enforcement (Lucas, 1983; Manning, 2003). Education is usually preferred over enforcement as it provides managers ‘light-handed’ options for lessening visitor-induced impacts. This approach is particularly appropriate in the management of wilderness and other backcountry areas as education is considered to be more in line with the spirit of the Wilderness Act (Hendee & Dawson, 2002). The oft-cited quote from former US Forest Service (USFS) Chief Max Peterson (1985) serves

to highlight the position of our nation's land managers regarding the preference for education over enforcement to obtaining compliance in wilderness: "*Wilderness management is 80-90 percent education and information and 10 percent regulation.*"

To meet this end, a variety of minimum-impact visitor education programs and strategies have been developed over the past 30 years to help curtail the impacts of recreationists, including Leave No Trace, Codes of Conduct, and Guidelines for Tourists (Marion & Reid, 2007). While specific messages vary between educational strategies, education provides managers tactics to promote conservation/stewardship behaviors (Hendee, Stankey, & Lucas, 1990; Roggenbuck & Berrier, 1982), raise awareness (Ballantyne & Uzzell, 1999), lessen instances of depreciative behavior (Kimmel, 1999), increase knowledge (Cole, Hammond, & McCool, 1997), influence attitudes, and enhance the experience (Ham, 1992). Indeed, research has shown education to be preferred by both managers (Washburne & Cole, 1983) and visitors (Hendee, et al., 1990) in protected area contexts over more direct methods such as sanctions or regulations.

One of the earliest minimum-impact visitor education programs was initiated in the 1960s when the USFS began to encourage 'pack it in – pack it out' messages to the public. This fledgling effort was based in part on the success of the anti-forest fire campaign (ex: Smoky Bear) and was aimed to reduce littering in wildlands. These early messages are now considered precursors to Leave No Trace (LNT) (Marion & Reid, 2001). By the 1980s, it was evident that a more comprehensive education program was needed to address impacts from recreationists upon the nation's wildlands. To help meet the need of educating the recreating public, the USFS teamed with the National Outdoor

Leadership School (NOLS) in the early 1990s to refine the LNT message (Marion & Reid, 2001). The current LNT message is built upon the research of recreation ecologists used to inform the development of a broad conceptual framework made up of seven principles suitable for application in a multitude of environmental settings (Monz, 1994). The LNT message was adopted by the four primary federal land management agencies, the Bureau of Land Management, Fish and Wildlife Service, and NPS in the Department of the Interior and USFS in the Department of Agriculture, in 1993 as part of a Memorandum of Understanding ([www.lnt.org](http://www.lnt.org)). As they stand today (January, 2009), the seven LNT principles are: (1) Plan ahead and prepare, (2) Travel and camp on durable surfaces, (3) Dispose of waste properly, (4) Leave what you find, (5) Minimize campfire impacts, (6) Respect wildlife, and (7) Be considerate of other visitors.

There are a large number of studies examining the efficacy of visitor education to influence human behaviors, going back to at least Fazio's (1979) study of camping practices at Rocky Mountain National Park. Investigations addressing the efficacy of LNT are, however, much less frequent within the literature and largely atheoretical, despite the wide use of persuasion and communication theory in education research. Still, there are several LNT oriented studies applicable to this investigation (Christensen & Cole, 1999; Confer, Absher, Graefe, & Hille, 1999; Harding, Borrie, & Cole, 1999; Newman, Manning, Bacon, Graefe, & Kyle, 2003; Reuhrwein, 1998; Stubbs, 1991). Please note that the individual manuscripts (journal articles, Chapters 3, 4, & 5) and the literature review (Appendix A) contains full reviews of this literature, thus, the following is simply a brief synopsis of the three most applicable LNT studies. Miller, Borrie, and



Harding (2001) completed a review of the primary theoretical factors thought to influence the practice of minimum-impact (i.e. LNT) behaviors. While not directly testing any of the structures reviewed, their research served to direct future research and informed our theoretical orientation for the present investigation. Stubbs (1991) investigated objective knowledge of low-impact practices (quiz) and the effectiveness of visitor education at lessening instances of visitor induced recreational impacts. Knowledge was found to be low, a result he attributed to changing agency recommendations regarding practices. Additionally, while a positive correlation was discovered between knowledge of proper campsite attributes and selection of actual campsites, the study was hindered by a small number of observations. Reuhrwein (1998) examined self-reported backcountry behaviors of recreationists through the lens of the Theory of Reasoned Action (Fishbein & Ajzen, 1975). However, Reuhrwein's study used single-item measures of attitudes, which likely contributed to the weak to nonexistent (significant) correlations between the study's primary constructs.

In short, a comprehensive review of the literature indicated that despite widespread calls for research (Cole, 1998; Confer, et al., 1999; Wright, 2000), no systematic evaluation of the LNT program has been conducted and the understanding of the determinants of compliance is still minimal (Marion & Reid, 2001; Miller, et al., 2001; Roggenbuck, 1992) .

## Synopsis of the Theoretical Frameworks

The utilization of theory can provide insight for understanding phenomenon of interest by providing guidance into the correct types and forms of questions and steer variable selection and operationalization of study constructs (Henderson, Preseley, & Bialeschki, 2004). This dissertation utilized a combination of Ajzen's Theory of Planned Behavior (1991) to investigate the theoretical drivers of compliance with the seven LNT principles and Rogers Diffusion of Innovations Theory (2003) to explore the diffusion and perceived efficacy of LNT in the two NPS units studied.

### *Theory of Planned Behavior*

The Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) and its successor the Theory of Planned Behavior (TPB) (Ajzen, 1991) are general theories of social psychology that examine the antecedents of human behavior. Taken together they are perhaps the two most widely utilized social psychological theories pertaining to the antecedents of behavior (Armitage & Conner, 2001; Francis, et al., 2004; Sheppard, Hartwick, & Warshaw, 1988). The theories contend that as rational actors, behavior is best predicted by an individual's behavioral intention (BI) to engage in said behavior. According to the TRA, BI is a product of the interaction of attitudes (AT) towards the outcome of a behavior (rational assessment) and the influence of social norms (SN), i.e. peer pressure (Fishbein & Ajzen, 1975). The TPB extends the TRA through the inclusion of a third construct, perceived behavioral control (PBC) (Ajzen, 1991, 2002), usually likened to Bandura's theory of Self-Efficacy (Bandura, 1977). The construct was added in an attempt to create a predictive model that would capture behaviors of interest that

were outside of an individual's complete volitional control (Ajzen, 1991). Eagly & Chaiken defined PBC as the belief an individual holds regarding "how easy or difficult it is to perform the behavior" (1993, pp. 186-187). Conner and Armitage (1998) described PBC as a 'continuum,' with one end marked by behaviors completely under the control of the actor while the other end of the spectrum distinguished by behaviors much more difficult (to impossible) to carry out. Underlying AT, SN, and (in the case of TPB) PBC constructs are what researchers term a core set of behavioral beliefs (Ajzen, 1991). Individuals form beliefs about themselves, other people, products, behaviors, and institutions among others (Fishbein & Ajzen, 1975). Beliefs can be manipulated through direct experience, from outside sources, including other people, via educational messages, or through media sources.

#### *Diffusion of Innovations*

The study also used Roger's Diffusion of Innovation (2003) Theory as the conceptual framework for investigating the level of adoption and diffusion of the LNT program and the effectiveness of different dissemination strategies such as web sites, personal communication, and printed media. How do innovations, those ideas, practices or objects that are new, become adopted into society? What causes one idea to rapidly become infused while others do not? Innovations succeed or fail for any number of reasons; Diffusion of Innovations (DT or Diffusion Theory) seeks to understand how an idea becomes accepted by exploring the variables that help account for adoption (Rogers, 2003). Diffusion is defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (Rogers,

2003, p. 5). By better understanding the factors that influence adoption, more efficient strategies for introducing and diffusing innovations into society can be developed. To date some 5,200 publications have used Diffusion Theory with approximately 120 new studies per year utilizing the theory (Rogers, 2003). Surprisingly, Diffusion Theory has received little application within the natural resource management literature and no application within visitor compliance/minimum-impact research (Wright, 2004). Further, additional understanding of DT has been identified as a tool to lessen the lag-time between scientific research and implementation by natural resource management (Wright, 2004). For the present investigation, theoretical insight gleaned from DT can aid our investigation of visitors' awareness levels of the LNT program and potentially offer guidance with developing strategies to more effectively disseminate the LNT message.

### Problem Statement

In protected area management, influencing visitor behavior to assist meeting management objectives can be a particularly complicated challenge. To facilitate meeting these challenges, managers frequently utilize visitor education strategies considered more in-line with the spirit of the Wilderness Act rather than more overt measures such as sanctions or enforcement. The most pervasive visitor education strategy used in protected area contexts is LNT, an educational initiative designed to lessen the impacts of recreationists upon the landscape. There is however, a lack of understanding regarding the effectiveness of LNT and the determinants of compliance

with recommended practices is nominal (Cole, 1998; Confer, et al., 1999; Marion & Reid, 2007; Wright, 2000).

### Study Purposes

In light of the lack of understanding regarding the effectiveness of LNT, the purpose of this dissertation was to examine overnight NPS backcountry visitors' behavioral intentions to comply with widely promoted LNT principles as well as their opinions regarding the efficacy of various LNT education delivery strategies. Insight into the determinants of compliance with recommended LNT practices coupled with greater understanding of visitors' opinions regarding key education dissemination strategies can lead to the development of more effective visitor education potentially resulting in the reduction of visitor-induced impacts. Further, this research aimed to provide a baseline of understanding and the necessary foundation for the development of a larger scale research effort to fully assess the effectiveness of the LNT message promoted on public lands. This study developed and tested several new psychometric measures suitable for investigations of LNT in protected area contexts. Finally, the results of this study are intended to inform management decisions regarding the future direction of the LNT program in the NPS and improve existing education tools to reach a broader segment of the recreating public and enhance both enjoyment and resource protection.

## Study Goals

The corresponding abstracts of the three future contributions to the literature are as follows:

### *Manuscript #1 (Chapter 3)*

This article discusses the conceptual foundation, development, cross-validation, and psychometric qualities of the Backcountry Visitor Ethics Scale – Version 1 (BCVES-V1), a research instrument designed to measure salient attitudes regarding the six ‘on-trail’ LNT principles. In backcountry contexts, education is the preferred management strategy for mitigating impacts and LNT is the most pervasive education program in existence. Further understanding of salient attitudes regarding the LNT message can lead to more effective implementation of educational interventions potentially resulting in recreational behaviors that lessen visitor-induced impacts. Primary study data were collected from overnight backcountry visitors to Olympic National Park, WA (N=314) and Glacier National Park, MT (N=279) during the summer, 2007. Using confirmatory factor analysis, the resulting measurement model, a second-order three-construct 15-item scale, exhibited satisfactory fit properties across both samples and is largely consistent with the conceptual framework used to develop the measure. Directions for those interested in using the scale are provided along with managerial implications and directions for future improvements to the measure.

### *Manuscript #2 (Chapter 4)*

Leave No Trace (LNT) is an education program designed to promote minimum-impact behaviors in backcountry settings. The educational program was formally

adopted by the US National Park Service (NPS) in 1993, however there is limited knowledge regarding the effectiveness of the program and the determinants of compliance. To meet this end, an extended version of the Theory of Planned Behavior (TPB) was operationalized and empirically evaluated using structural equation modeling to gauge the theory's effectiveness in predicting behavioral intentions to comply with promoted LNT guidelines. The traditional TPB model was extended through the use of a self-reported knowledge variable. Data were collected via a mail-back questionnaire from overnight backcountry users in two NPS Units: Olympic National Park, WA (N=313) and Glacier National Park, MT (N=279) utilizing a mailback survey method. Results indicate the extended version of the TPB can explain as much as 44.3% of the variance in intentions to comply with promoted practices however, the predictors of intentions vary by unit. Discussion regarding significant predictors of intentions to comply with recommended LNT practices is provided as well as advice and guidance for those charged with dissemination of the LNT message in protected area contexts.

*Manuscript #3 (Chapter 5)*

The purpose of this article is to discuss the diffusion and perceived effectiveness of the Leave No Trace (LNT) Visitor Education Program in two NPS Units. LNT is the most pervasive environmental ethics communication initiative in existence and is designed to encourage human powered recreationists in backcountry settings to minimize their impacts upon the landscape. This article explores the potential for Diffusion of Innovations Theory (Rogers, 2003) to offer insight into improving educational effectiveness in natural resource management contexts. Data were collected during the

summer of 2007 from overnight backcountry recreationists in Glacier National Park, MT, and Olympic National Park, WA following a modified Dillman (2007) procedure. Results indicate the vast majority of respondents were aware and highly supportive of the LNT program, and highlight the role of both family-friends as well as the NPS for diffusing the LNT message amongst recreationists. T-test analyses indicate marginal effectiveness of four primary dissemination strategies on self-reported knowledge of principles; however, effectiveness varies widely by unit. Significant and negative beta coefficients exist between perceived skill level regarding backcountry travel and perceptions of information gleaned from various LNT dissemination strategies, potentially indicating the presence of an ‘expert’ like mentality amongst the populations sampled. For the practitioner, management implications and suggestions for more effectively disseminating the LNT message amongst the recreating public are offered.

### Study Objectives

To address the study purposes, the principal content of this dissertation is presented as three stand-alone journal manuscripts (articles). The primary study objectives of each of these future contributions to the literature are as follows:

#### *Manuscript #1 (Chapter 3)*

1. Establish the validity of the hypothesized measurement model based on the current LNT principles using current psychometric ‘best practices.’
2. Confirm the first-order attitudinal factors composing a LNT attitude.
3. Test for the presence of a second-order ‘LNT Ethic’ factor.



4. Demonstrate construct validity and measurement invariance through the cross-validation of the measurement model with a second, independent sample.

*Manuscript #2 (Chapter 4)*

1. Establish the validity of the hypothesized measurement model using current psychometric ‘best practices.’
2. Demonstrate construct validity and measurement invariance through the cross-validation of the measurement model with a second, independent sample.
3. Identify, through the lens of TPB, significant predictors of behavioral intentions to comply with promoted LNT practices.

*Manuscript #3 (Chapter 5)*

1. Identify what proportion of respondents are aware of LNT.
2. Examine initial and primary sources of LNT information.
3. Ascertain if global attitudes regarding the efficacy of the LNT Program and self-reported knowledge of LNT principles differ between NPS Units investigated and the relationship between these two variables.
4. Discover what proportion of respondents’ four key LNT education dissemination strategies reach and the perceived efficacy of these strategies. Test if perceptions of effectiveness differ between units.
5. Within NPS Units, determine if levels of self-reported knowledge of LNT principles differ between those exposed to a dissemination strategy and those who were not.

6. Examine if respondents perceptions of their backcountry skill level and self-reported knowledge of LNT principles influences what they perceived learning from the four dissemination strategies.

### Site Selection Criteria

Glacier National Park (GNP), Montana and Olympic National Park (ONP) Washington, were selected based upon the following criteria: large contiguous wilderness/de facto wilderness areas suitable for multiday backcountry trips, recognition as backpacking destinations in popular media, required backcountry permits, and pre-trip check-ins with ranger staff. Each of the parks also uses a range of education dissemination strategies and represent different geographic locations and ecosystems. Glacier National Park encompasses approximately one million acres of forests, lakes, and mountain peaks. Annually, the park receives 25,000 backcountry overnight visitor stays, primarily concentrated in the months of July and August. Olympic National Park is a geographic medley of rugged coastline, temperate rainforest, and high alpine peaks and meadows. Covering nearly one million acres, the park is 95% designated wilderness. In 2006, the ONP hosted approximately 40,000 overnight backcountry visitor nights.

### Definition of Terms

*Leave No Trace (LNT)* –a minimum-impact visitor education initiative designed to lessen impacts of recreationists upon the landscape.

*Minimum-impact visitor education* – visitor education designed to promote ‘best-practices’ regarding ethical behavior in backcountry. Examples include Leave No Trace, Codes of Conduct, & Tread Lightly!.

*Recreation ecology* – the study of human-caused recreational impacts on the natural environment (Hammit & Cole, 1998; Leung & Marion, 2000).

*Sociological impacts* – Impacts that negatively influence the visitor experience in wildlands. Examples of such impacts include conflict, crowding, visual or auditory disruptions of the experience among others.

*Structural equation modeling* – a family of advanced statistical techniques that allow the researcher to specify (a priori) and test a theoretical structure (Byrne, 2006; Kline, 2005).

## Study Contributions

This study positioned to make significant contributions to the current body of knowledge regarding LNT education for influencing backcountry camping behaviors, particularly within protected area contexts at both theoretical and practical levels. At the theoretical level, this research utilized relevant frameworks as a vehicle to operationalize primary study constructs, which is something that has been lacking in the majority of previous investigations. This research also extends the theoretical understanding of the influence of visitors’ attitudes toward LNT behaviors in backcountry contexts and their opinions regarding key education dissemination strategies. The theoretical insight gained from this study can then be used by practitioners to improve the provision of LNT

education on public lands. This is an important contribution as the LNT program has been adopted by the four primary federal land management agencies and all 50 state park directors.

From a practical standpoint, this research serves to inform those charged with promotion of the LNT program ‘food for thought’ as they develop and refine educational intervention strategies to better meet management objectives. Finally, preliminary results from this research endeavor have been presented at the annual International Symposium on Society and Resource Management (ISSRM) in Park City, UT (June 2007), at ISSRM in Burlington, VT (June 2008), at the annual meeting for Society for Conservation Biology (SCB) in Chattanooga, TN (July 2008), and at the biannual George Wright Society Conference, Portland, OR (March, 2009).

#### Dissertation Outline

The layout of the dissertation departs slightly from the format normally used by the social sciences in that it contains three individual journal articles (Chapters 3, 4, & 5) suitable for submission to peer-reviewed outlets as well as three supporting chapters (Chapters 1, 2 & 6). Chapter One provides background information, puts forth the problem statement, study purposes, study goals, and study objectives and summarizes the study site selection criteria, offers a synopsis of the theoretical frameworks used to operationalize variables, defines key terms, and reviews contributions the study makes to the field. Chapter Two presents methods and procedures undertaken to conduct the research and meet the study’s purposes and goals. Chapters Three, Four, and Five are

presented as three independent journal articles suitable for submission to peer-reviewed journals in the leisure and/or conservation social science field. Respectively, these chapters examine 1) the process and procedures undertaken to develop and cross-validate a multi-dimensional scale to assess backcountry camping ethics, 2) the viability of the Theory of Planned Behavior for predicting behavioral intentions to comply with promoted LNT practices as well as exploring the feasibility of an extended version of the model, and 3) the diffusion and perceived efficacy of the LNT message across the two NPS units investigated. Chapter Six offers a more descriptive summation of results and is written primarily for those charged with dissemination of the LNT message in protected area contexts. Chapter Six also provides recommendations for future research efforts and summative conclusions.

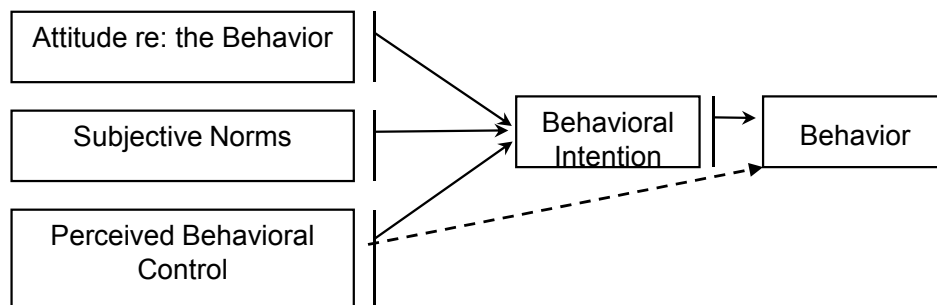
There are also three appendices in this dissertation. Appendix A provides a succinct literature review of environmental education and interpretation as mechanisms for influencing behavior to meet management objectives. The appendix concludes by discussing the evolution, current standing, and research base of the LNT visitor education program. Appendix B provides commentary on the two theoretical frameworks that guided development and operationalization of the questionnaire utilized in the study beyond that covered in the respective journal articles. Appendix C contains the statement of work, questionnaire utilized to collect primary study data as well as various supporting information including cover letters and reminder postcards.

## CHAPTER 2

### METHODS

#### Introduction & Chapter Overview

This chapter is presented as three sections that, taken together, review the methods undertaken to address the study goals and objectives. Section One describes the processes undertaken to develop, purify, and refine the study measures. Section Two reviews operationalization of variables by theoretical construct for those variables used in one or more of the three stand-alone manuscripts (Chapters 3, 4, & 5). The third section reviews study sites and sampling procedures utilized for the research as well as procedures undertaken to assess the potential of nonresponse bias. Figure 2.1 displays the primary theoretical framework tested in this dissertation. A full discussion of the theoretical framework is provided in Appendix B and procedures for testing the model are in Chapter 4.



*Figure 2.1* Theory of Planned Behavior (Ajzen, 1991)

## Item Development, Purification, & Refinement

The following six subsections review the processes undertaken to develop, purify, and refine study measures.

### *Theoretical & Conceptual Orientation*

Theory has been defined as ‘the construction of explicit explanations in accounting for empirical findings’ (Bengtson, Burgess, & Parrott, 1997, p. 572). The use of applicable theory in research contexts can provide guidance for understanding phenomenon of interest by providing insight into the correct types and forms of questions or items as well as guide variable selection and operationalization of study constructs (Henderson, et al., 2004). For instance, behavioral change theory can potentially identify determinants of human behavior through the illumination of pathways that may lead to the mechanisms we are most interested in influencing (Ham, 2007a). Communication theory may provide insight into the best strategy for effective message delivery. In this investigation, the Theory of Planned Behavior (Ajzen, 1991), a behavioral change theory, and Diffusion of Innovations Theory (Rogers, 2003), a general theory of communication, were operationalized to help meet the study goals and objectives presented in Chapter One.

In addition to the use of a theoretical framework to guide research, a conceptual framework can similarly inform decision-making processes regarding variable development and operationalization. Conceptual frameworks are particularly helpful for determining wording of items/questions and scope of study constructs. This investigation utilized the LNT principles as a conceptual framework to assist with defining constructs,

item generation and refinement, and later as a priori dimensions tested via confirmatory factor analysis procedures.

### *Initial Variable Development*

Based upon previous empirical investigations (Belcher, 2004; Cole, et al., 1997; Confer, et al., 1999; Daniels & Marion, 2005; Newman, et al., 2003; Reuhrwein, 1998; Stubbs, 1991) and several books dedicated to minimum-impact camping practices (Hampton & Cole, 2003; Harmon, 1997), item pools and questions were generated to cover the scope of theoretical constructs explored in this dissertation. Due to the multidimensional nature of the LNT principles and the necessity of clearly and unambiguously operationalizing TPB constructs, the majority of time and effort went into developing the attitudinal construct of TPB.

This section focuses on the development of the attitudinal scale presented in Section C of the questionnaire in Appendix C. The six ‘on-trail’ LNT principles (principles two through seven) were utilized as a conceptual framework to develop the attitudinal item pool. The goal of this phase was to generate a set of indicators reflective of the various latent factors (LNT principles) of interest (Jarvis, MacKenzie, & Podsakoff, 2003). Several scale anchor wording options were assessed, including; levels of appropriateness, acceptability, agreement, and importance. The seven-point anchor ‘very inappropriate’ to ‘very appropriate’ ultimately selected to anchor items. The items (Table 3.1) were written to solicit maximum variation in responses and sought to measure respondents’ attitudes of appropriateness regarding a specific backcountry behavior. For example, one item reads ‘Having a campfire’ (item CF-1). Having a campfire in the



backcountry has been, and will likely continue to be, common practice among many backcountry campers; however, the LNT principles recommend forgoing a fire to lessen environmental impact. Indeed, all of the items presented in Table 1 are considered inappropriate backcountry behaviors under the strictest interpretation of the LNT principles.

#### *Expert Panel Review*

The developing item pool was next reviewed by a panel of backpacking instructors (N=8) at a large southeastern university. During this phase, reviewers independently evaluated the items against the LNT principles for scope, clarity, and coverage. Members of the expert panel also provided other additional items and/or wording changes. Particular attention went to eliminate poorly worded items, double-barreled items, items that would have likely solicited highly skewed scores, and unreasonably long items. Prior to pilot testing the total number of items was reduced from 97 to 73.

#### *Pilot Testing*

The attitudinal items were subjected to a pilot test using a sample (N=225) of Parks, Recreation, and Tourism Management students and Psychology Department students at Clemson University during the spring semester, 2007. Students were told the study was part of a NPS study. The 73 items were randomized to lessen potential instances of measurement bias and formatted into a three-page questionnaire. The response rate was 100%. Approximately 60% of the sample was female with an average age of 20.4. Univariate statistics for each of the 73 items pilot tested were examined for

measures of central tendency, including means, standard deviations (item variance), and unreasonable skew and kurtosis issues (Tabachnick & Fidell, 2001). The BCVES-V1 was hypothesized a priori to be multi-dimensional, thus correlations were examined amongst items within each of the six LNT principles. In multi-item scale development, items that are highly correlated are similarly highly reflective of an underlying latent variable (DeVellis, 2003).

Next, a confirmatory factor analysis (CFA) was undertaken to analyze pilot test data. Confirmatory factor analysis allows researchers to evaluate a priori hypothesized latent variable structures given theoretical or empirical evidence (Byrne, 2006). A primary advantage of CFA is that the process allows the ability to test the degree of ‘fit’ of a hypothesized factor structure and its associated parameter estimates (factor loadings) to assess model quality (Byrne, 2006; Hurley, et al., 1997). In addition, CFA is increasingly being used by researchers during scale development procedures (Gould, Moore, McGuire, & Stebbins, 2008; Noar, 2003).

The pilot sample was subjected to CFA procedures utilizing the EQS v6.1 software package (Bentler, 2005) with the end goal identifying a core set of items to include in the primary study. The measurement model was constructed sequentially, initially by examining one-construct (one LNT principle) at a time. After a reasonable fit was obtained for each of the six latent constructs (factors) independently, the process became construct additive. Here again, the process was sequential with latent constructs freely estimated. It was also determined at this time to collapse LNT principles Five (be considerate of other visitors) and Six (leave what you find) into a more holistic ‘Respect’

category for a number of reasons. The latent constructs correlated perfectly (value of 1) indicating they reflected the same underlying concept. This finding indicated the appropriateness of collapsing these two latent constructs into one to simplify the conceptual framework. Second, this permitted us to reduce the number of observed variables (items) necessary to represent the latent variable while still covering the domain of interest. Third, in most wildland environments, negative impacts are caused primarily through improper travel and camping practices, improper handling of waste, and campfires. By collapsing the two latent variables into one, we were able to reduce the number of observed variables necessary for this factor and keep the primary focus centered on LNT Principles Two (Travel & Camping Practices), Three (Dispose of Waste Properly), and Four (Minimize Campfire Impacts). This line of reasoning is similar to Stubbs (1991), who likewise reduced the scope of his research to concentrate on only a select few primary LNT principles. At the conclusion of the pilot data analysis phase, we retained 29 of the original 73 items.

*IRB, NPS Social Science Office, & OMB Review*

The Clemson University Institutional Review Board (IRB) was sent the questionnaire on April 1, 2007 with approval granted on April 12, 2007. The instrument was then sent to the NPS Social Science Office for review on April 12, 2007. Based upon review by NPS Social Science staffers, minor wording changes were made to study items and questions. Next, the instrument was provided to the Office of Management Budget (OMB) on May 15 2007 for review/approval. This review resulted in several

revision iterations and mandatory cognitive interviewing to further purify study measures.

### *Cognitive Interviewing*

Cognitive interviews were conducted at the Apgar Backcountry Ranger Station in St. Mary's Village, Glacier National Park, MT primarily to further assess the validity of the attitudinal items (Section C of the questionnaire in Appendix C). Cognitive interviewing is a process in which researchers can fine-tune measurement indices to lessen potential instances of confusion or misinterpretation (Willis, 1999). Participants were overnight backpacking groups (N=18 individuals) with procedures followed those recommended by Willis (1999). These interviews lasted approximately 25 minutes each and interviews were repeated until a point of data saturation, i.e. redundancy in responses, was achieved. The process highlighted that respondents were able to complete the items without difficulty and without the assistance of the researcher. Findings also suggested that the majority of items did not solicit confusion. Retrospective probing supported the finding that respondents understood the items and were able to match their responses with the anchor statements provided. Twenty-two of the original 29 items were retained at the conclusion of the cognitive interviewing process. Of the seven items eliminated, most were eliminated because of wordiness or because of concern expressed by interviewees about the item in question potentially soliciting confusion.

## Operationalization of Items by Theoretical Framework & Construct

The following section discusses the final items/questions used to operationalize study constructs grouped by theoretical framework.

### *Theoretical Framework #1: Planned Behavior*

#### *Behavioral Intentions:*

Behavioral intention to follow minimum-impact guidelines were measured via three items on a seven-point Likert-type scale (1=Strongly Disagree, 4=Neutral, 7=Strongly Agree).

#### *Attitudes re: Specific LNT Behaviors*

Attitudes regarding various LNT practices were measured via 15-items for the CFA article (Chapter 3) and via 11 items for the SEM article (Chapter 4). Both articles utilized the same three construct, first-order structure: attitudes regarding travel and camping practices, attitudes regarding waste management, and attitudes regarding campfire use. The seven-point scale ‘very inappropriate’ (1) to ‘very appropriate’ (7) was used to anchor items.

#### *Subjective Norms*

The influence of subjective norms was assessed via two items anchored on seven-point scale (+1 to +7), anchored by strongly disagree – strongly agree.

#### *Perceived Behavioral Control & Perceived Difficulty*

Perceived Behavioral Control-Perceived Control (PBC-PC) was evaluated via three items on a seven-point scale using the anchors 1=not at all under my control, 4=neutral, 7=completely under my control. Consistent with Traifmow et al. (2002), a

second dimension of perceived behavioral control was measured; perceived difficulty (PBC-PD) assessed via three items anchored on a seven-point scale ranging from very difficult (1) to neutral (4) to very easy (7).

## *Theoretical Framework #2: Diffusion of Innovations*

### *Awareness of LNT*

Respondents were asked if they had ever heard of Leave No Trace. Those who answered ‘yes’ were asked to indicate the year they first learned of LNT.

### *Initial & Primary Sources of LNT*

Respondents were asked to indicate both their initial and primary sources of LNT information from eight predetermined response categories: family/friends, information kiosk/park literature, popular media (magazines, books), class/course, park personnel/park education talk, boy/girl scouts, LNT webpage, internet, and a space for ‘other.’

### *Communication Channels: Four LNT Educational Dissemination Strategies*

Exposure to and perceived effectiveness of four dissemination strategies were examined (face-to-face, video, printed literature, website). A two-part question was devised to assess the extent of which these dissemination strategies were reaching intended audience members and the perception of respondents regarding their effectiveness. Respondents were asked to indicate if they had been exposed to each of the dissemination strategies (yes or no). Those who answered ‘yes,’ were asked to indicate how much they perceived learning about LNT from the experience, using a 7-point scale ranging from ‘0’ (nothing) to ‘6’ (extensive amount).

### Global Attitudes regarding LNT

Four items were used to assess global attitudes regarding LNT. A sample item reads ‘it is important to use minimum-impact/LNT techniques when in the backcountry.’ Items were measured on a 7-point scale ranging from 1=strongly disagree to 7=strongly agree.

### *Miscellaneous Items & Study Constructs*

#### Experience Use History

Respondents were asked to report three aspects related to their experience use history (EUH) (Schreyer & Lime, 1984) with overnight backcountry camping. If they camped overnight in the backcountry of the park before being contacted for this study (yes/no), the year they first camped overnight in a backcountry setting (any location) (continuous), and the average number of backcountry trips taken per year (any location) (continuous).

#### Self-Reported Knowledge of LNT principles

Self-reported knowledge regarding LNT was measured via the statement ‘how would you describe your current knowledge of Leave No Trace practices?’ Response categories were 0=no knowledge, 1=very limited, 2=limited, 3=average, 4=above average, 5=extensive and 6=expert.

#### Self-reported Backcountry Skill Level

Backcountry skill levels were measured with the following multiple-choice question: ‘regarding the skills necessary for backcountry travel, I consider myself a:’ Response categories were 1=novice, 2=beginner, 3=intermediate, 4=advanced, 5=expert.

## Study Sites, Target Population, & Sampling Procedures

### *Site Selection Criteria*

Site selection was based upon the following criteria; large contiguous wilderness/defacto wilderness areas, recognition in popular media as backpacking destinations, large numbers of overnight backcountry travelers, willingness to cooperate with the research team, and mandated check-ins with ranger staff prior to the trip at a limited number of permit issuing sites. Note: defacto wilderness areas are areas of land managed as wilderness but that do not have official congressional designation as wilderness. Regarding this last point, for example overnight backcountry visitors to Glacier National Park can only obtain permits at one of five stations and over 60% of all backcountry visitors obtain their permits at the Apgar Backcountry Visitor Center on the west gate into the park. Conversely, at Great Smoky Mountains National Park, overnight visitors can obtain a permit via a self-service information kiosk at any number of trailheads across the park.

### *Overview of Sites Selected*

Based upon the previously discussed site selection criteria, Olympic National Park and Glacier National Park were selected as study locations. A brief description of each follows:

Located primarily in northwestern Montana with portions extending into Idaho and British Columbia, Canada, Glacier National Park is frequently referred to as “the crown of the continent.” The park stretches over one million acres with over 95% of the parks’ total land mass slated for inclusion within the National Wilderness Preservation



System. Straddling the continental divide, the park is a medley of high peaks, lush alpine valleys, and lakes. The park was selected for three principal reasons. Backpacker Magazine has repeatedly named the park as a top backpacking destination. Additionally, the park receives, on average, 25,000 annual backcountry visitor nights, primarily concentrated in July & August. Finally, all backcountry visitors are required to obtain their permit in one of five locations; Apgar Backcountry Permit Center, St. Mary Visitor Center, Many Glacier, Two Medicine/Polebridge Ranger Stations, and Waterton Lakes National Park Visitor Reception Center (Canada) with over 60% of total visitors using the Apgar Backcountry Permit Center.

The second site, Olympic National Park (ONP), is located on the Olympic Peninsula in the northwest corner of Washington State. The park provides a geographic combination of rugged coastline, temperate rainforest, and high alpine peaks and meadows. Covering nearly one-million acres, approximately 95% of the park is designated wilderness. According to NPS statistics use office, there were approximately 40,000 overnight backcountry visitor nights in 2006. Olympic National Park was chosen as a site for this research for three overarching reasons. First, within the NPS, Olympic has the reputation of being one of the most proactive units in promoting the LNT message amongst backcountry visitors. By including Olympic, we were able to observe firsthand and document, visitor education efforts, with the end possibility of making a case study for other NPS units to emulate. Secondly, and as previously mentioned, Olympic encompasses a large landmass that is geographically diverse, potentially providing opportunity to sample overnight backcountry travelers participating in a

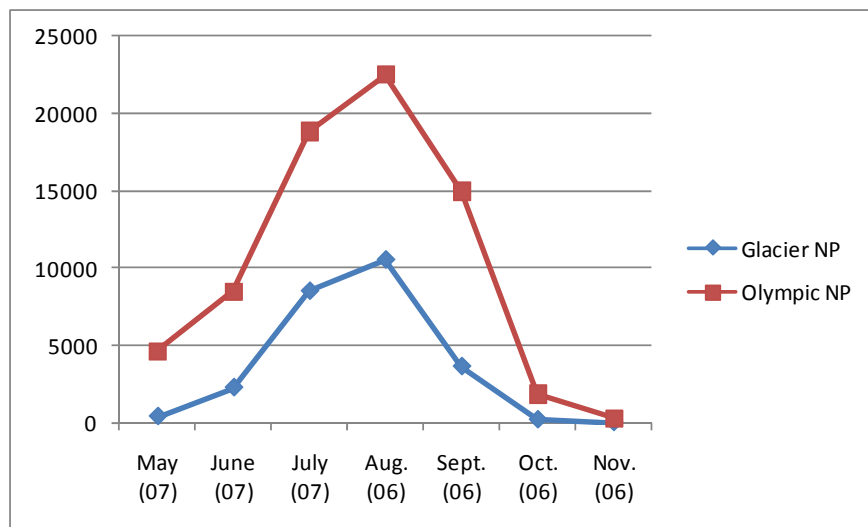
number of activities like sea kayaking, hiking, and alpine mountaineering. Finally, all backcountry visitors are required to obtain their backcountry permits in one of three locations within the park; the Wilderness Information Center (WIC) in Port Angeles, Quinault Wilderness Office, and/or at the Forks Recreation Information Station allowing the researcher to obtain a large, representative sample of park users.

#### *Respondent Universe (Study Population)*

The respondent universe (population of interest) was adult backcountry travelers participating in an overnight backcountry trip within the two NPS Units during the study period.

#### *Collection Procedures for Contact Information*

Contact information was obtained by a systematic sampling strategy at a time chosen to coincide with annual historical peak visitation (Figure 2.2). A systematic sampling strategy to obtain contact information was undertaken to ensure both representativeness and a more accurate estimate of the error (Babbie, 2001).



*Figure 2.2 Backcountry Use by Month*

The author of this dissertation collected contact information from GNP visitors from Saturday, June 23, 2007 until Wednesday, July 11, 2007. Contact information in ONP was collected from July 21, 2007 until August 4, 2007. Backcountry camping parties were intercepted upon their arrival at the respective permit issuing stations in the two NPS Units. All adult group members present were asked to participate in the study. The goal of the sampling design was to sample all party members as past studies have shown that less experienced backcountry travelers rely heavily on more experienced individuals as sources of information (Ramthun, 1998). Each permit holder was asked to introduce the researcher to the entire backcountry party if not all members were present at the time of the intercept. Over 96% of those asked agreed to participate and completed a contact card.

#### *Collection Procedures for Primary Study Data*

Collection of primary study followed a modified Dillman (2007) technique with multiple contacts (N=3) to increase the response rate. All individuals who completed a contact card were mailed a cover letter reiterating the purpose of the study and a questionnaire (see Appendix C for copies of these documents). Ten business days later, those who had not returned a questionnaire were mailed a reminder postcard. Ten days after the post-card was sent, those who had still not returned a questionnaire were mailed a second letter and a replacement questionnaire. After correcting for invalid addresses/undeliverable questionnaires, an adjusted response rate of 73% for ONP and 68% for GNP was achieved (N=314 & 279, respectively).

*Non-response Bias Testing:*

A non-response bias check was undertaken to ascertain if differences existed between respondents and non-respondents. Nonrespondents were systematically selected from the original contact sheet using a random start point. Repeated attempts were made via telephone to contact every 5<sup>th</sup> nonrespondent. These procedures continued until approximately 30 individuals per unit were contacted and successfully interviewed. The data were examined using t-tests with mean values examined on five 'continuous' variables; group size, length of stay (nights), total years of backcountry camping experience, self-reported knowledge of LNT principles. No significant differences between respondents and nonrespondents were found across NPS Units on the variables Group Size and Length of Stay ( $p > .05$ ). Respondents did differ significantly from nonrespondents on the variable Self-reported Knowledge of LNT principles, with nonrespondents indicating higher levels of knowledge. This may be an artifact of two different interview styles (self-administered mail-back questionnaire vs. oral interview). ONP respondents also differed from nonrespondents on the variables years of backcountry camping experience, with respondents having approximately 7 years more backcountry experience. This finding is consistent with many public opinion surveys which routinely find respondents are older (hence, in this case respondents have more backcountry experience) (Dillman & Carley-Baxter, 2000). It is inferred that potential data contamination due to nonresponse bias is minimal.

Table 2.1

*T-test comparisons of respondents and nonrespondents*

Unit	Variable		N	Mean	SD	t-statistic	p-value
GNP	Group Size	Respondents	279	2.8	1.3	.46	.645
		Nonrespondents	31	2.7	1.0		
	Length of Stay: Nights Out	Respondents	279	2.7	1.8	-.15	.885
		Nonrespondents	31	2.8	1.7		
	Years of Backcountry Camping Experience	Respondents	273	13.4	12.0	1.75	.087
		Nonrespondents	31	10.4	8.7		
	Self-reported Knowledge of LNT Principles	Respondents	268	4.2	.9	-3.23	.001
		Nonrespondents	31	4.7	.8		
ONP	Group Size	Respondents	313	3.8	2.7	.59	.552
		Nonrespondents	28	3.5	2.3		
	Length of Stay: Nights Out	Respondents	314	2.6	1.6	-.49	.627
		Nonrespondents	28	2.7	1.9		
	Years of Backcountry Camping Experience	Respondents	302	21.7	14.4	2.41	.016
		Nonrespondents	28	14.8	13.8		
	Self-reported Knowledge of LNT Principles	Respondents	303	4.0	.9	-2.86	.005
		Nonrespondents	28	4.5	1.0		
	Age	Respondents	311	41.7	12.5	1.95	.052
		Nonrespondents	28	36.8	14.5		

CHAPTER 3 (MANUSCRIPT #1)

DEVELOPMENT, PSYCHOMETRIC QUALITIES, AND CROSS-VALIDATION OF  
THE BACKCOUNTRY VISITOR ETHICS SCALE – VERSION 1 (BCVES-V1)

Intended Outlet

Leisure Sciences (article < 9,000 words)

Abstract

This article discusses the conceptual foundation, development, cross-validation, and psychometric qualities of the Backcountry Visitor Ethics Scale – Version 1 (BCVES-V1), a research instrument designed to measure salient attitudes regarding the six ‘on-trail’ LNT principles for responsible recreation. Leave No Trace (LNT) Principles Education is the preferred management strategy for mitigating impacts from recreationists in backcountry contexts and LNT is the most pervasive backcountry recreation skills and ethics education program in existence. Further understanding of salient attitudes regarding the LNT message can lead to more effective implementation of educational interventions potentially resulting in recreational behaviors that lessen visitor-induced impacts. Primary study data were collected from overnight backcountry visitors to Olympic National Park, WA (N=314) and Glacier National Park, MT (N=279) during the summer, 2007. Using confirmatory factor analysis, the resulting measurement model, a second-order three-construct 15-item scale, exhibited satisfactory fit properties across both samples and is largely consistent with the conceptual framework used to develop the

measure. Directions for those interested in using the scale are provided along with managerial implications and directions for future improvements to the measure.

#### Keywords

Leave No Trace, LNT, Backcountry Visitor Ethics Scale, environmental attitudes, confirmatory factor analysis

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## Introduction & Purpose

Protected area managers frequently utilize education based strategies as mechanism to mitigate negative human caused impacts (Douchette & Cole, 1993). Leave No Trace (LNT), an educational program designed to educate visitors regarding proper backcountry practices, is the most pervasive of such educational messages currently in existence. The message consists of seven principles designed to encourage an environmental ethic and influence human behavior to lessen human-caused impacts. The LNT program has been adopted by the four primary federal land management agencies (Bureau of Land Management, Fish and Wildlife Service, US Forest Service, and National Park Service), as well as the National Association of State Park Directors representing some 5,482 parks (Marion & Reid, 2001; [www.lnt.org](http://www.lnt.org)). Yet despite the widespread adoption of this important visitor education tool, the research base remains inadequate (Cole, 1998; Marion & Reid, 2001; Miller, et al., 2001; Wright, 2000).

The purpose of this article is to describe the development, psychometric properties, and cross-validation of the Backcountry Visitor Ethics Scale – Version 1 (BCVES-V1), a research instrument designed to provide a standardized metric for assessing attitudes concerning the Leave No Trace (LNT) principles for responsible recreation. The instrument was constructed based on the premise that attitudes, more than knowledge, ultimately determine behavior (Ajzen, 1991; Eagly & Chaiken, 1993; Stern & Oskamp, 1987), particularly in environmental contexts (Pooley & O'Connor, 2000; Robertson, 1981; Weigel & Weigel, 1978). The instrument was conceived as a necessary component of a larger study examining LNT in a selection of US National Park



Service Units (Powell, Wright, & Vagias, 2008) when it became clear that a multi-item scale to assess attitudes regarding various LNT oriented behaviors did not exist. Data were collected from a systematic sample of backcountry overnight visitors to Olympic National Park, WA (N=309) and Glacier National Park, MT (N=275) during the summer, 2007. This article details the process involved in the development and empirical evaluation of the resultant scale, including cross-validation of the final measurement model with a separate independent sample.

#### Conceptual Framework: The Leave No Trace Principles for Responsible Recreation

Theory has been defined as ‘the construction of explicit explanations in accounting for empirical findings’ (Bengtson, et al., 1997, p. 572) and is widely recognized as to providing valuable insight into research design, specifically in the selection and/or development of measurement indices (DeVellis, 2003). In the absence of relevant theory, a conceptual framework can inform research decision-making processes. This investigation utilized the LNT principles (Figure 3.1) as a conceptual framework to help guide key aspects of the investigation including defining constructs, item generation and refinement, and later as a priori dimensions tested via confirmatory factor analysis procedures.

Leave No Trace Principles (www.lnt.org)

1. Plan ahead and prepare
2. Camp and travel on durable surfaces
3. Dispose of waste properly
4. Minimize campfire impacts
5. Be considerate of other visitors
6. Leave what you find
7. Respect wildlife

*Figure 3.1 Leave No Trace Principles*

At present, LNT is the most widely disseminated environmental education message addressing human powered outdoor recreationists in existence. The seven principles are designed to provide human powered outdoor recreationists with a set of core ‘best practices’ to limit their impact on the natural world with the end goal of influencing behavior to support management objectives (Hampton & Cole, 2003; Harmon, 1997). Because the ultimate goal of LNT is to improve recreationists’ behaviors to minimize environmental impact, the focus of the BCVES-V1 was to measure attitudes regarding specific behaviors that occur while in backcountry contexts. As evident in Figure 3.1, LNT principle #1 addresses behaviors that occur prior to an individual engaging in outdoor recreation activities. This principle, while an integral part of any backcountry experience, does not deal directly with recreational practices in backcountry per se. Consequently, it was decided to not include this principle in the development of the BCVES-V1. LNT principles Two through Seven do however address behaviors and common practices that occur while ‘on the trail’ and are thus included in the developing index. *This distinction is critical, as the BCVES-V1 is specifically designed to address attitudes that pertain to actions occurring in backcountry settings.*

Principle number two is *Travel and Camp on Durable Surfaces*. Key backcountry practices related to this principle include hiking single-file (while on trails), not cutting trail switchbacks, camping where impacts already exist, and establishing camp on surfaces durable enough to sustain the impact. The third principle of LNT is *Dispose of Waste Properly*. This principle pertains to common backcountry practices such as the disposal of human waste, handling of dishes and dishwater, and the removal of trash/litter from backcountry settings. Principle four is *Minimize Campfire Impacts* and is dedicated to educating backcountry users regarding the reduction of campfire impacts. LNT principles five and six refer to respect towards other visitors (*Be Considerate of Other Visitors*) and respect for anything found (titled *Leave What You Find*). LNT principle seven, *Respect Wildlife*, addresses appropriate human – wildlife interaction (for further information regarding the LNT principles, see Harmon, 1997).

## Literature Review

### *Environmental Attitudes*

One of the initial and now recognized shortcomings with early environmental behavioral change research was the assumption that a linear relationship exists between knowledge and behavior change. In short, early theorists assumed that behavior could be influenced by informing individuals of the consequences of their actions. Various research agendas have subsequently elucidated the shortcomings with this supposition and it is now viewed as flawed (Hungerford & Volk, 1990). Instead, psychological theory now suggests human behavior is largely driven by salient attitudes regarding the behavior in

question (Ajzen, 1991; Fishbein & Ajzen, 1975), leading some authors to contend that ‘the utility of the attitude concept rests upon its predictive validity (to predict subsequent behavior)’ (Tarrant & Green, 1999, p. 18). In the field of environmental psychology, the correspondence between stronger environmental attitudes and environmentally friendly behavior has been demonstrated empirically by Tarrant & Greene (1999), Cottrell (2003), Kaiser, Wolfing, & Fuhrer (1999), Newhouse (1990), and Roberts & Bacon (1997) amongst others. For this research, additional understanding of recreationists’ salient attitudes can inform more targeted educational interventions potentially resulting in recreational behaviors that lessen visitor-induced impacts.

The majority of previous empirical investigations to measure environmental attitudes have focused on general or holistic dimensions of environmental attitudes. Perhaps the most well-known of these general measures is the New Environmental Paradigm Scale (NEP), originally introduced by Dunlap & Van Liere (1978). While the NEP has received widespread use (Ewert, Place, & Sibthorp, 2005; Mobley, Vagias, & DeWard, Forthcoming; Thapa, 2001), it does not address specific environmental attitudes per se and instead focuses on general environmental orientation. Other wide-ranging scales designed to assess environmental attitudes exist in the literature, including the Environmental Concern (Weigel & Weigel, 1978), Awareness of Consequence (Stern, Dietz, & Kalof, 1993), and Forest Values (Steel, List, & Schindler, 1994). These scales, like the NEP, lack the specificity deemed necessary to measure LNT attitudes and were deemed unsuitable for the current investigation.

There are several backcountry oriented attitudinal measures in existence (Hendee, Catton, Marlow, & Brockman, 1968; Stankey, 1973). One of the first of such examples of a ‘wilderness’ measurement tool was introduced by Hendee and others (1968). The scale consisted of 30 value-type statements designed to differentiate users based on such constructs as features, activities, and perceived benefits of a wilderness experience. A second scale, the ‘Wilderness Purism Scale,’ was introduced by Stankey (1973) who devised the scale ‘to meet the need for a unit of analysis that would recognize the wide range of individual involvement, concern, and knowledge about wilderness among the respondents’ (1973, p. 10). However, like the general environmental attitudinal scales described earlier, these backcountry specific measures lacked the specificity necessary to assess attitudes regarding minimum-impact backcountry practices.

#### *Recreation Ecology & Backcountry Visitor Education Studies*

To provide an overview of past studies addressing backcountry recreation impacts and visitor attitudes/behaviors, we categorized past research efforts into three groups: 1) visitor behavior in backcountry, 2) visitor induced resource impacts, and 3) visitor education strategies.

A variety of research efforts have explored visitor behavior in backcountry environments. Christensen and Cole (1999) examined preferences of wilderness visitors in eight different US wildernesses regarding campsite locations (proximity to lakes) and the use of cook stoves while camping. Still others have investigated human waste disposal (Cilimburg, Monz, & Kehoe, 2000), campfire impacts (Reid & Marion, 2005),

leaving what is found (Widner & Roggenbuck, 2000), and consideration of other visitors (Manning & Valliere, 2001).

A significant body of research also exists assessing the impact of visitors on the landscape, or what is termed ‘recreation ecology’ (Hammitt & Cole, 1998; Leung & Marion, 2000). These studies have examined damage to trees, campfire impacts, loss of ground cover, trampling effects, and soil compaction among other biophysical impacts (Cole, 1992; Cole & Spildie, 1998; Leung & Marion, 2000). As discussed by Daniels & Marion (2005), such studies have largely discovered an ‘asymptotic use-impact relationship,’ meaning the majority of impact occurs initially and cumulative impacts begin to level over time (see also Hammitt & Cole, 1998).

Similarly, there have been extensive investigations into the efficacy of visitor education for influencing visitor use patterns, knowledge, attitudes, and depreciative behavior (for review see Manning, 2003). The effect of information on visitor use patterns has been explored by a number of researchers (Krumpe & Brown, 1982; Lime & Lucas, 1977; Roggenbuck & Berrier, 1982) with Manning (2003) concluding information to address use patterns is particularly effective if available during trip planning. Visitor knowledge studies are reviewed in the ‘LNT Investigations’ section. After reviewing studies by Manfredo, Yuan, and McGuire (1992) and Bright et al, (1993) amongst others, Manning (2003) concluded education can effectively modify visitor attitudes. Finally, it is acknowledged that depreciative behavior can be effectively addressed via education (Manning, 2003).

#### *LNT Investigations*

There are relatively few theoretically based empirical investigations specifically exploring LNT and those in existence have primarily addressed knowledge of LNT practices (for a complete list of LNT related research see [www.lnt.org](http://www.lnt.org)). In an early study, Fazio (1979) examined Rocky Mountain National Park visitors knowledge of low-impact practices utilizing multiple choice tests, concluding that overall knowledge levels among respondents was low. Dowell & McCool (1986) assessed Boy Scouts' knowledge of LNT post education program utilizing a 7-question scale. Results from this study indicated that treatment group knowledge increased both immediately after treatment and one-month post treatment. More recent contributions have included work by Newman, Manning, Bacon, Graefe, and Kyle (2003) who evaluated Appalachian Trail hikers knowledge of minimum-impact (aka LNT) skills. A number of contributions to the current state of LNT knowledge have originated with graduate student masters theses. Stubbs (1991) assessed visitors to Shining Rock Wilderness knowledge of low-impact camping practices and the effectiveness of printed media (posters) on backcountry practices. He concluded posters addressing three practices; campsite selection, tent placement, and use of stoves, raised knowledge levels, increased behavioral knowledge in the desired direction, and improved behavior (observed). Reuhrwein (1998) assessed knowledge and self-reported behavior of backcountry recreationists in southern Utah's redrock country through the lens of the Theory of Reasoned Action (Fishbein & Ajzen, 1975). However, the study used single item measures of attitudes, which were the likely culprit for the weak to nonexistent (significant) correlations between primary study constructs.

A large majority of past LNT oriented studies have utilized knowledge as the outcome variable (Dowell & McCool, 1986; Fazio, 1979; Reuhrwein, 1998; Stubbs, 1991). There are two primary concerns with knowledge based assessment tools. Firstly, such tools utilize a dichotomous answer format (right or wrong) and thus solicit minimal amounts of variability. The second concern is the recognition that human behavior is determined more by attitudes (Ajzen, 1991; Eagly & Chaiken, 1993) than knowledge, particularly in environmental contexts (Kaiser, et al., 1999; Pooley & O'Connor, 2000; Weigel & Weigel, 1978). Other research substantiates the need to move away from knowledge-based assessment tools to attitudinal or belief-based measures. Consider findings from Stubbs (1991), who concluded that even though recreationists might know the 'correct' answer regarding backcountry practices, their behavior may not consistently reflect that knowledge. Newman et al., concluded "standardized measures of minimum-impact knowledge and skills based on these principles (LNT) should be developed" and that "better understanding of visitors knowledge and associated behavior will allow managers to shape and implement information dissemination programs that are more likely to be effective in protecting park and wilderness resources and the quality of visitor experiences" (2003, p. 33 & 34). We agree that a standardizing measures is necessary, it is argued that the measure should not address knowledge of behavioral practices but rather attitudes regarding the behaviors in question. This current effort is designed to fill this recognized need in the literature.



## Development of the BCVES-V1

### *Preliminary Steps*

A scale is more than a collection of items; a well designed scale allows assessment of complex theoretical or conceptual constructs that would otherwise be unobservable (DeVellis, 2003). For a scale to emerge from a set of items, the items need to be reflective of a latent (or unobservable) construct, frequently illuminated or confirmed through factor analysis procedures. This study followed procedures outlined by DeVellis (2003) as our primary guide with additional direction from Noar (2003), and Gould, et. al., (2008).

Based upon previous empirical investigations (Belcher, 2004; Cole, et al., 1997; Confer, et al., 1999; Daniels & Marion, 2005; Newman, et al., 2003; Reuhrwein, 1998; Stubbs, 1991) and several books dedicated to minimum-impact camping practices (Hampton & Cole, 2003; Harmon, 1997), an item pool was generated (N=80 items). These items were developed utilizing the six ‘on-trail’ LNT principles (#s 2 – 7) as a conceptual framework where each individual item was written to align with a specific LNT principle. The goal of this phase was to generate a set of indicators reflective of the various latent factors (LNT principles) of interest (Jarvis, et al., 2003). Several anchor-wording options were assessed, including; levels of appropriateness, acceptability, agreement, and importance with the seven-point anchor ‘very inappropriate’ to ‘very appropriate’ ultimately selected to anchor items. The items (Table 3.1) were written to solicit maximum variation in responses and sought to measure respondents’ attitudes of appropriateness regarding a specific backcountry behavior. For example, one item reads

‘Having a campfire’ (item CF-1). Having a campfire in the backcountry has been, and will likely continue to be, common practice amongst many backcountry campers; however, the LNT principles recommend forgoing a fire to lessen environmental impact. In fact, all of the items (see Table 3.1) are considered inappropriate backcountry behaviors under strict interpretation of the LNT principles. The developing item pool was next reviewed by a panel of backpacking instructors (N=8) at a large southeastern university. During this phase, reviewers were asked to independently evaluate the items against the LNT principles for scope, clarity, and coverage. Members of the expert panel also provided other additional items and/or wording changes. Finally, prior to pilot testing the total number of items was reduced from 97 to 73. Particular attention was paid to eliminate poorly worded items, double-barreled items, items that would have likely solicited highly skewed scores, and unreasonably long items.

### *Pilot Testing*

The 73 items were then randomized to lessen potential instances of measurement bias and formatted into a questionnaire that was subsequently administered as a pilot test to 225 undergraduate students at a major southeastern university. Students were told the study was part of a National Park Service (NPS) study. The response rate was 100%. Approximately 60% of the sample was female with an average age of 20.4. Univariate statistics for each of the 73 items pilot tested were examined for measures of central tendency, including means, standard deviations (item variance), and unreasonable skew and kurtosis issues (Tabachnick & Fidell, 2001). The BCVES-V1 was hypothesized a priori to be multi-dimensional, thus correlations were examined amongst items within

each of the six LNT principles. In multi-item scale development, items that are highly correlated are similarly highly reflective of an underlying latent variable (DeVellis, 2003).

Next, a confirmatory factor analysis (CFA) was conducted to analyze pilot test data. A CFA analysis strategy allows researchers to evaluate a priori hypothesized latent variable structures given theoretical or empirical evidence of such and is increasingly being used by researchers during scale development procedures (Byrne, 2006; Kline, 2005). Conversely, exploratory factor analysis (EFA) is used when “a researcher has relatively little theoretical or empirical basis for making strong assumptions about how many common factors exist” (Fabrigar, Wegener, MacCallum, & Strahan, 1999, p. 272). One of the primary advantages of CFA is it allows researchers the ability to test the ‘fit’ of a hypothesized factor structure by providing a variety of statistical measures for assessing the degree of ‘fit’ and ‘misfit’ present in a model and its associated parameter estimates (factor loadings) (Byrne, 2006; Hurley, et al., 1997). However, it is explicitly recognized that once respecification based on model fit criteria commences, the analysis is no longer completely ‘confirmatory’ (Gerbing & Hamilton, 1996).

The pilot sample was subjected to CFA procedures utilizing the EQS v6.1 software package (Bentler, 2005) with the end goal identifying a core set of items to include in the primary study. The measurement model was constructed sequentially, initially by examining one-construct (one LNT principle) at a time. After a reasonable fit was obtained for each of the six latent constructs (factors) independently, the process became construct additive. Here again, the process was sequential with latent constructs

freely estimated. It was also determined at this time to collapse LNT principles Five (be considerate of other visitors) and Six (leave what you find) into a more holistic 'Respect' category. This was done for several reasons. First, the latent constructs correlated perfectly (value of 1) indicating they reflected the same underlying concept; consequently, collapsing these two latent constructs into one allowed us to simplify the conceptual framework. Second, this permitted us to reduce the number of observed variables (items) necessary to represent the latent variable while still covering the domain of interest. Finally, in most backcountry environments, negative impacts are caused primarily through improper travel and camping practices, improper handling of waste, and campfires. By collapsing the two latent variables into one, we were able to reduce the number of observed variables necessary to represent this factor and keep the focus centered on LNT principles Two (Travel & Camping Practices), Three (Dispose of Waste Properly), and Four (Minimize Campfire Impacts). This line of reasoning is similar to Stubbs (1991), who likewise reduced the scope of his research to concentrate on only a select number of the LNT principles. At the conclusion of the pilot data analysis phase, we retained 29 of the original 73 items.

### *Cognitive Interviews*

A series of cognitive interviews were conducted at the Apgar Backcountry Ranger Station in St. Mary's Village, Glacier National Park, MT to refine the BCVES-V1. Cognitive interviewing is a process in which researchers can fine tune measurement indices to lessen potential instances of confusion or misinterpretation (Willis, 1999). Participants in the interviews included overnight backpacking groups (18 individuals)

with procedures followed those recommended by Willis (1999). All interviews lasted approximately 25 minutes and were conducted until a point of data saturation (redundancy in responses) was achieved. The process illuminated that all respondents were able to complete the items without difficulty and without the assistance of the researcher. Findings also suggested that the majority of items did not solicit confusion. Retrospective probing supported the finding that respondents understood the items and were able to match their responses with the anchor statements provided. At the conclusion of the cognitive interviewing process, we retained 22 of the 29 original items. Of the seven items eliminated, most were removed on the basis of wordiness or concern expressed by interviewees about the item potentially soliciting confusion.

## Methods

### *Study Locations & Sampling*

Two NPS units were selected for inclusion in this research: Glacier National Park (GNP), Montana and Olympic National Park (ONP), Washington. Selection was based upon the following criteria; large contiguous wilderness areas, recognition in popular media as backpacking destinations, large numbers of overnight backcountry travelers, willingness to cooperate with the research team, and mandated check-ins with ranger staff prior to the trip at a limited number of permit issuing sites. For example, overnight backcountry visitors to GNP can only obtain permits at one of five stations and over 60% of users utilize the Apgar Backcountry Visitor Center on the west gate into the park.

Conversely, at Great Smoky Mountains National Park overnight visitors can obtain a permit via a self-service information kiosk at any number of trailheads.

The sample was selected by systematically intercepting individuals and groups as they picked-up their backcountry permits at primary backcountry offices/ranger stations in the two respective NPS Units. The time-period was specifically chosen to coincide with historical peak use. During the intercept, contact information was collected after consent to participate was granted. All members of a group present age 18 or older were asked to provide their contact information, thus allowing for the sampling of all adult party members, not just the registered trip leader. Over 95% of all individuals asked consented to participate and completed a contact card. Primary data collection followed a modified tailored design method using a mailed questionnaire. Multiple contacts (N=3) were used to increase the response rate (Dillman, 2007). A response rate of 73.4% at ONP (N=314) and 68.4% at GNP (N=279). A non-response bias check was conducted via telephone with non-respondents (N=30/unit) across several variables with no significant differences indicated between those who responded and those who did not.

#### *Data Screening & Imputation*

Cases missing more than 50% of data (N=8 total; four in each sample) were dropped prior to screening, imputation, or analysis. Data were initially screened independently using SPSS V.16 for both univariate and multivariate outliers with particular attention paid to cases exhibiting undue leverage or discrepancy (Tabachnick & Fidell, 2001). Two cases, one from each sample, were deemed to exceed recommended cut-off values and were eliminated from further analyses (Fox, 1991).

Thirty-three cases from the ONP sample and 25 cases from the GNP sample were missing one or more data points across the 22 items assessed (Table 3.1), less than 1.5% of total data points in each respective sample. A missing data analysis was conducted using EQS 6.1 (Bentler, 2005) to examine if significant patterns of missingness existed. Test results concerning the homogeneity of covariance matrices indicated the pattern of missing data can be considered missing completely at random for both the ONP ( $\chi^2=1622.2$ ,  $df=1596$ ,  $p=.318$ ) and GNP ( $\chi^2=1201.5$ ,  $df=1386$ ,  $p=.999$ ) samples (Allison, 2003). To address missing data, we elected to impute rather than follow more conventional methods such as listwise deletion which suffers from lower power for hypothesis testing and wider confidence intervals or pairwise deletion which results in unspecified sample size (Allison, 2003). Missing data were imputed via EQS v6.1 (Bentler, 2005) using an expectation maximization imputation procedure (Allison, 2003). There were no multivariate atypical cases post-imputation.

#### *Model Assessment & Modification Criteria*

Confirmatory factor analysis was used to construct all models. Model construction proceeded sequentially using the EQS v6.1 software platform (Bentler, 2005) and maximum likelihood estimation. Structural equation modeling based analyses, of which CFA is an element, provided a number goodness-of-fit (GOF) statistics that offer insight into the appropriateness of the specified model. A single ‘global’ measure of fit is nonexistent, thus researchers are encouraged to report multiple measures for assessing model quality (Kline, 2005). Consistent with this advice, we report the Satorra-Bentler Scaled Chi-Square (S-B $\chi^2$ ), Comparative Fit Index (CFI), Standardized Root

Mean Square Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA) and its associated 90% confidence interval. Mardia's coefficient indicated the presence of nonnormality within both datasets (Byrne, 2006), a fact not uncommon in behavioral and social research (Micceri, 1989). Transformations were not considered to allow meaningful interpretation of scores on items and because skew values were minimal on most observed variables (Table 3.1). The S-B $\chi^2$  was chosen over standard chi-square as it is more suitable for data exhibiting signs of nonnormality by correcting (Hampton & Cole 2003; Harmon, 1997)□, an item pool was generated (N=80 items). 'misfit' in that a p-value of less than .05 indicates the covariance structure of the researchers hypothesized model differs significantly from the observed covariance matrix. However, with large samples it is likely that a significant model chi-square will be obtained (indicating poor model fit), even if the model fits the observed data well (Byrne, 2006). The CFI and RMSEA fit statistics reported are based on robust estimates. The CFI is an incremental fit less susceptible to sample size than other similar measures such as Normed Fit index (Kline, 2005). The CFI is based on scale of 0 to 1; values greater than .9 indicating an acceptable fit and values greater than .95 indicative of an excellent fit to the data (Hu & Bentler, 1998). The SRMR statistic provides an indication of differences between observed and predicted covariances with a value of less than .1 considered acceptable (Kline, 2005). The RMSEA is based on the analysis of residuals in the model with values from .05 to .08 acceptable and values <.05 considered excellent (Browne, 1982; Steiger, 1988). The Lagrange Multiplier (LM) Test was used during configural measurement model construction to explore areas of 'misfit,' i.e. parameters



which if freed would significantly improve overall model fit. Care must be exercised however in considering the theoretical soundness of each modification indicated by the LM test (Byrne, 2006). This is due to the fact that the LM test is completely empirical, and statistical improvements must not supersede theoretical criteria (Tabachnick & Fidell, 2001).

## Results

### *Participant Characteristics*

Approximately 60% of ONP respondents were male with an average age of 41.4. Greater than 63% of the GNP sample was male with a mean age of 36.2 years. Over 97% of ONP respondents and 99% of GNP respondents identified themselves as White (not of Hispanic descent). Greater than 90% of all respondents reported having a bachelors degree or higher. Slightly over half of respondents were registered as the trip leader. Nine out of ten respondents sampled indicated to have traveled primarily with friends and/or family members. Two out of three respondents (66.3%) reported to have camped in the backcountry of ONP prior to being asked to participate in the current study while only one out of every four GNP respondents indicated to having camped in the backcountry of GNP prior to be contacted for this study (24.5%).

### *Item Descriptive Statistics*

Table 3.1 displays the means, standard deviations, and skew of the 22 items. Mean scores are based upon the seven-point scale previously described: lower scores reflect attitudes more congruent with recommended LNT principles. Review of

descriptive statistics indicated significant measurement issues with the two items designed to assess the latent factor 'respect wildlife' (LNT principle #7). Mean scores indicated a minimal amount of variability for each variable across both samples (mean<1.2, SD<.75, skew > 5.25). Review of frequency statistics showed that greater than 96% of respondents in each sample indicated a '1' or '2' for these items and including these items would not contribute meaningful explanatory power to the resultant scale so it was determined to eliminate this construct from the BCVES-V1.

Table 3.1

*Means, Standard Deviations, and Skew for the BCVES-V1 (Shaded Items Dropped in Final Model)*

Item ID	Items <sup>a</sup>	ONP			GNP		
		M	SD	Skew	M	SD	Skew
<i>LNT Principle #2 - Camp and Travel on Durable Surfaces</i>							
TC-1	Walking around muddy spots on the trail	4.01	1.55	-0.09	4.33	1.67	-0.17
TC-2	Hiking side by side with my friends on existing backcountry trails	2.94	1.59	0.58	2.89	1.67	0.73
TC-3	Camping along the edge of a stream or lake	3.77	1.91	0.08	4.22	1.92	-0.11
TC-4	Moving rocks from where I plan to place my tent	4.73	1.67	-0.53	4.33	1.63	-0.37
TC-5	Moving rocks and/or logs to make a campsite more comfortable	4.24	1.66	-0.28	3.60	1.72	0.16
TC-6	When camping in heavily used areas, placing the tent in an undisturbed spot	2.07	1.36	1.53	2.14	1.57	1.57
TC-7	In popular backcountry areas, camping where no one has camped before	1.75	1.20	1.84	1.77	1.22	1.93
TC-8	Camping two nights in a pristine camp	4.68	1.78	-0.41	4.87	1.73	-0.48
<i>LNT Principle #3 - Dispose of Waste Properly</i>							
DW-1	Burying used toilet paper	4.46	2.13	-0.30	4.19	2.21	-0.10
DW-2	Urinating on vegetation	3.46	1.68	0.22	3.16	1.65	0.32
DW-3	Using soap in streams as long as there are currents to help dilute the suds	1.96	1.31	1.54	1.90	1.26	1.52
DW-4	Depositing human waste on top of the ground so it will decompose rapidly	1.56	1.05	2.21	1.56	1.14	2.45
DW-5	Burning paper trash in the campfire	3.83	2.07	-0.08	3.17	1.86	0.32
DW-6	Disposing of dishwater in streams or lakes	1.53	1.05	2.51	1.53	0.94	1.93
<i>LNT Principle #4 - Minimize Campfire Impacts</i>							
CF-1	Having a campfire	4.10	1.82	-0.26	4.13	1.66	-0.13
CF-2	Cooking over a fire in the backcountry	3.74	1.90	0.01	3.85	1.87	0.03
CF-3	Building a fire ring if one is not present	2.81	2.04	0.73	2.41	1.93	1.21
CF-4	Leaving charred wood contained in the fire ring	4.13	1.90	-0.21	3.86	1.85	-0.03
<i>LNT Principles #5 &amp; #6 - Be Considerate of Other Visitors/Leave What You Find</i>							
CL-1	Keeping a single small item like a rock or feather as a souvenir	3.51	1.73	0.10	2.90	1.73	0.64
CL-2	Camping with large groups (8 or more people) in the backcountry	2.98	1.61	0.56	3.10	1.67	0.47
<i>LNT Principle #7 - Respect Wildlife</i>							
RW-1	Dropping food on the ground to provide wildlife a food source	1.19	0.65	5.70	1.19	0.70	5.57
RW-2	Feeding wildlife	1.19	0.71	5.29	1.15	0.59	5.70

<sup>a</sup> measured via 7-point scale; 1=very inappropriate, 4=neutral, 7=very appropriate

### *Configural Model Development*

The configural models were developed utilizing responses from the ONP sample of overnight visitors (N=309) using the items presented in Table 3.1. The ONP data was chosen as the sample was less homogenous than the GNP sample and was slightly larger. Goodness-of-fit statistics regarding model evolution are presented in Table 3.2. Items within constructs were hypothesized to be unidimensional. With all first order models tested, the variance of the factor was fixed to one to provide meaningful factor loadings for each observed variable, latent variables were expected to be correlated, and error terms, unless otherwise specified, were not allowed to correlate. The LM test was requested in each analyses to identify sources of misfit in each model (Kline, 2005).

Table 3.2  
*Configural Model Evolution of the BCVES-V1 (ONP sample)*

<i>Model</i>	<i>Model Description</i>			<i>Goodness-of-fit statistics</i>				
	<i>Factor Structure</i>	<i>1st order Factors</i>	<i># Items</i>	<i>S-B <math>\chi^2</math></i>	<i>df</i>	<i>CFI</i>	<i>SRMR</i>	<i>RMSEA (90% CI)</i>
1	One factor	1	20	571.1	170	.703	.078	.088 (.080-.096)
2	Four factors	4	20	463.2	164	.779	.074	.078 (.069-.086)
3	Four factors	4	17	206.4	114	.906	.056	.052 (.040-.063)
4	Three factors	3	17	207.8	116	.906	.056	.051 (.039-.062)
5a	Three factors	3	15	153.8	87	.920	.054	.050 (.037-.063)
5b <sup>a</sup>	Three factor	3	15	140.3	86	.935	.052	.045 (.031-.058)
6 <sup>a</sup>	2nd order	3	15	146.4	87	.929	.054	.047 (.033-.060)

<sup>a</sup> contains a cross-load from Factor 1 to the item 'Having a campfire'

Model One in Table 3.2 was a single factor null or baseline model. This model included all items in Table 3.1 loaded on a single factor with the exception of the two items representing ‘respect wildlife’ (dropped for reasons noted earlier). The model exhibited poor fit: CFI=.703, RMSEA=.088.

Model Two contained the 20 items in Table 3.1 with the factor structure specified to align with the conceptual framework (Figure 3.1). Goodness-of-fit of improved slightly from the null model, however it was considerably below admissible bounds (CFI=.779, RMSEA=.078). According to Bentler and Chou (1987), respecification of measurement models to generate a parsimonious solution should focus on the deletion of insignificant paths and/or items with large residuals/correlated error terms whose elimination will not sacrifice theoretical meaningfulness. Review of LM test results indicated significant error covariance between three sets of similarly worded items within the same two constructs; #2 *Travel and Camping Practices* and #5&6 (*Respect for others/what is found*). These items included: ‘moving rocks from where I plan to place my tent’ and ‘moving rocks and/or logs to make a campsite more comfortable’; items ‘using soap in streams as long as there are currents to help dilute the suds’ and ‘disposing of dishwater in streams or lakes’; and items ‘when camping in heavily used areas, placing the tent in an undisturbed spot’ and ‘in popular backcountry areas, camping where no one has camped before.’ Further, the highly inflated error covariances are likely an artifact of similarities in wording and given the high inter-item correlations (all >.50) these items appear to be measuring nearly identical concepts. Additionally, a perfect correlation ( $r=1.0$ ) was noted between these two latent factors. Given the similarities in wording

amongst the items described above, it was surmised that items in question were analogous and one from each set could be dropped without harming theoretical meaningfulness. Before dropping the problematic items, the finding was cross-validated by modeling the identical factor structure (Model #2) with the GNP data. The results were nearly identical regarding the item correlations and latent variable correlation discussed above. Thus, one item from each category was dropped; a step that significantly improved model fit by lessening error covariance without losing significant explanatory power of the model (Table 3.2).

Model Three eliminated three of the items identified as problematic in Model Two (see Table 3.1 for items dropped). Goodness-of-fit statistics indicated significant improvement in overall fit (CFI=.906, RMSEA=.056), however the perfect correlation between latent factors '*travel and camping practices*' and '*respect*' was still present. To cross-validate this finding, the model was replicated with the GNP data, which similarly indicated a perfect correlation between the latent variables. This finding indicates that respondents did not discriminate between these two LNT principles and that they can be combined to simplify the factor structure to achieve a more parsimonious solution.

Model Four maintained the 17 items evaluated in Model Three however, the factor structure was respecified as three factors, combining the two latent factors described previously. This new factor was renamed "general backcountry attitude" to more accurately reflect the indicators that comprise this latent variable. Goodness-of-fit were virtually unchanged however discriminate validity as represented by latent variable correlations between constructs improved.

The fifth configural model (5a Table 3.2) was the final first-order configural model. This model eliminated items TC-2 ‘hiking side by side with my friends on existing backcountry trails’ and item DW-5 ‘burning paper trash in the campfire’ due to significant and multiple error covariances and low factor loadings. This model also freely estimated a cross-loading from Factor 1 (General Backcountry Attitude) to the item ‘Having a campfire’ indicated by the LM test. This cross-loading is substantively meaningful if you consider that for ONP respondents having a campfire *is* part of the backcountry camping experience. Goodness-of-fit improved with a CFI value of .935 and an RMSEA value of .045.

Following arrival at the admissible solution presented in Model 5b, the factor structure was specified to include a second order latent construct, visually depicted in Figure 3.2. The inclusion of a higher-order construct allowed testing of the hypothesis that a single, second-order factor could account for the covariation between the three first order latent variables (General Backcountry Attitude, Disposal of Waste Attitude, and Campfire Attitude). The 2<sup>nd</sup> order structure for the measurement model is particularly appropriate given the highly correlated three first-order factors. Statistically, with only three indicators (first-order factors), the factor structure of Model 5b is identical to that depicted in Figure 3.2, the 2<sup>nd</sup> order structure. In order to estimate the path coefficients, the disturbance terms for Factors 1 (General Backcountry Attitude) & Factors 2 (Disposal of Waste Attitude) needed to be constrained equal, resulting in the increase of one degree of freedom in the second-order portion of the model. Both of these disturbance terms were of similar magnitude (for additional information on this process, see Byrne, 2006).

Goodness-of-fit statistics for this model (six) indicate that the data can be represented by a single higher order construct ( $S-B\chi^2=146.4$ ,  $df=87$ ,  $CFI=.929$ ,  $RMSEA=.047$ ). This higher order factor was termed Leave No Trace Ethic.

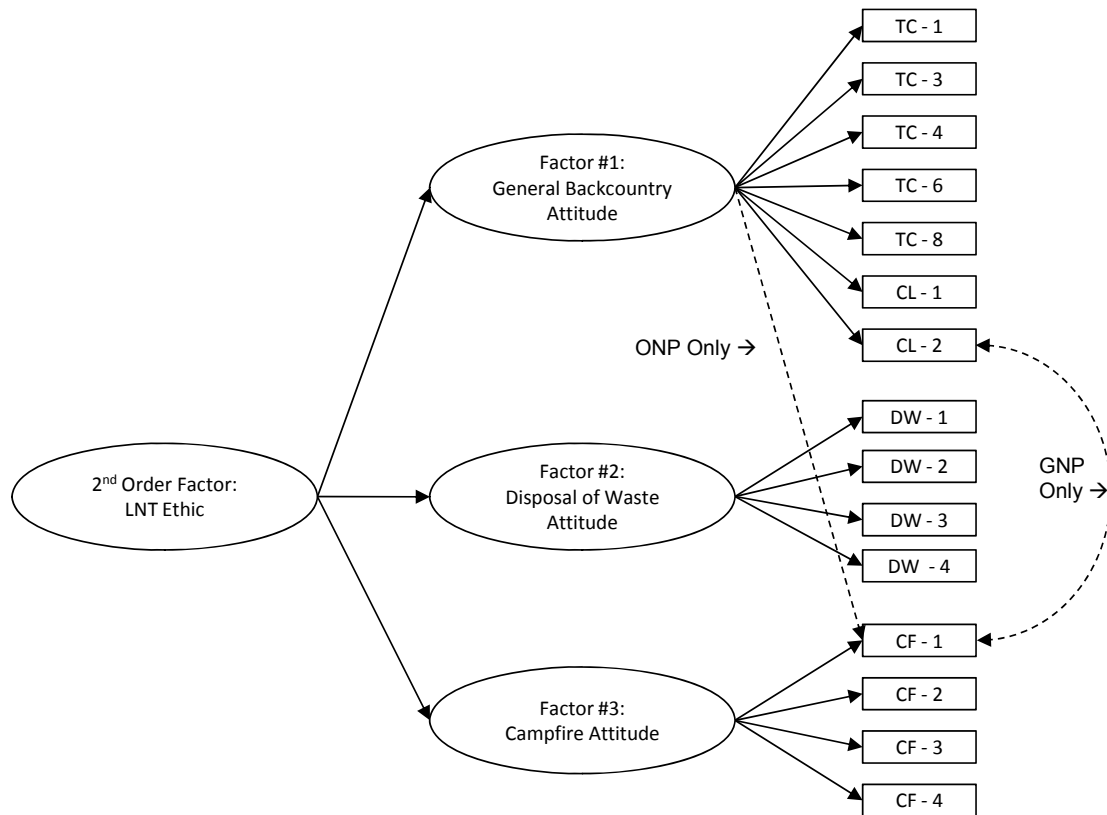


Figure 3.2 Final BCVES-V1 measurement model: 2nd order factor structure (Model #6)

### Cross Validation of the Configural Measurement Model

Assessing validity can provide insight as to how well a test is fulfilling its purported function (Anastasi & Urbina, 1998). However, a simple statistic or test to assess validity does not exist; instead, researchers must consider a number of different criteria. To address validity of the BCVES-V1 three key attributes were considered;



examining measurement invariance with an independent validation sample, multiple assessments of construct validity, and reliability.

### *Measurement Invariance*

Measurement invariance (MI) asks “if a set of indicators assesses the same construct in different groups” (Kline, 2005, p. 295). Examining for MI generally requires two hierarchical steps; examining if an identical factor structure exists across samples (configural invariance or ‘weak factorial invariance’) and examining if factor loadings are equivalent across samples (metric invariance or ‘strong factorial invariance’) (Byrne, 2006; Kline, 2005; Vandenberg & Lance, 2000). While rarely tested, the failure to demonstrate MI has been described as “threatening to substantive interpretations as is an inability to demonstrate reliability and validity” (Vandenberg & Lance, 2000, p. 6).

Configural invariance was initially examined by fitting the GNP data to Model 5a from Table 3.2 (results are presented in Table 3.3 alongside GOF statistics from ONP to facilitate). Fit was admissible (CFI=.907, RMSEA=.045), however a review of the LM test results indicated a significant error covariance between items ‘Camping with large groups (8 or more people) in the backcountry’ (item CL-2) and ‘Having a campfire’ (item CF-1). This finding is suggestive that GNP respondents viewed having a campfire as appropriate *if* camping with a larger group of individuals. Given the plausibility of this finding and its similarity to the cross-loading involving the same item with the ONP data, the model was respecified to include this error covariance (Model 5b:  $\Delta$ CFI=.033,  $\Delta$ RMSEA=.008).

Table 3.3  
Configural Invariance of the BCVES-V1

Model	NPS Unit	Model Description		Goodness-of-Fit Statistics				
		1st order Factors	# Items	S-B $\chi^2$	df	CFI	SRMR	RMSEA (90% CI)
5a	ONP	3	15	153.8	87	.920	.054	.050 (.037-.063)
5a	GNP	3	15	135.8	87	.907	.055	.045 (.030-.059)
5b <sup>a</sup>	ONP	3	15	140.2	86	.935	.052	.045 (.031-.058)
5b <sup>b</sup>	GNP	3	15	119.0	86	.937	.053	.037 (.019-.053)
6 <sup>a</sup>	ONP	3	15	146.4	87	.929	.054	.047 (.033-.060)
6 <sup>b</sup>	GNP	3	15	129.9	87	.918	.056	.042 (.026-.057)

<sup>a</sup> contains a cross-load from Factor 1 to item 'Having a campfire' (CF-1)

<sup>b</sup> models the error covariance between 'Camping with large groups (8 or more people) in the backcountry' (CL-2) and 'Having a campfire' (CF-1)

Of particular interest are the nearly identical and high loadings displayed in Table 3.4 between first order latent variables and the second order construct *LNT Ethic*. These high and nearly equal loadings provide empirical support and justification for the use of a higher-order (2<sup>nd</sup> order) factor to account for correlations amongst first order factors. The consistency of this finding across groups, coupled with the nearly equivalent fit statistics, provides strong evidence of the configural equivalence of the BCVES-V1.

Table 3.4  
Factor Intercorrelations (Model #5) & 2nd Order Loadings (Model #6)

Parameter/Variable	Model #5 Latent Variable Correlations				Model #6 2nd Order Factor: LNT Ethic	
	1		2		ONP	GNP
	ONP	GNP	ONP	GNP		
1. General Backcountry Attitude	--	--			.96	.96
2. Disposal of Waste Attitude	.84	.87	--	--	.90	.92
3. Campfire Attitude	.75	.83	.57	.50	.82	.81

Note. All parameter estimates statistically significant ( $p < .01$ )

To further substantiate configural invariance, we specified a multi-group model in the program statement and assessed GOF by running both datasets simultaneously (Byrne, 2006; Widaman & Reise, 1997). Model #5a was examined first as it lacked any sample unique error-covariances or cross-loadings. Goodness-of-fit was acceptable ( $S-B\chi^2=289.3$ ,  $df=174$ ,  $p<.001$ ,  $CFI=.910$ ,  $RMSEA=.048$ ). To conclude examination of configural invariance, Model 6 was specified as a multi-group model, without however the cross-loading (ONP) and error-covariance (GNP) as these were unique to each sample. Again, GOF was acceptable ( $S-B\chi^2=294.8$ ,  $df=174$ ,  $p<.001$ ,  $CFI=.910$ ,  $RMSEA=.049$ ).

Metric invariance is demonstrated through equality of factor loadings across groups (Vandenberg & Lance, 2000). As discussed by Byrne (2006), metric invariance is assessed through adequacy of GOF statistics and limited model degradation from the configural model when factor loadings are constrained to be equal between groups (see also Widaman & Reise, 1997). Metric invariance was examined for two models; the 1<sup>st</sup> order correlated factors model (Model 5a) and 2<sup>nd</sup> order structure (Model 6).

Initially Model #5a was specified with equality constraints imposed on all factor loadings (15 constraints) and both datasets run simultaneously. Similar to the test of configural invariance, Model 5a was chosen as it lacked any sample unique parameter estimations. Consistent with past efforts given the large number of constraints, we set alpha at .01 to lessen instances of a type one error (Gould, et al., 2008). Goodness-of-fit for the loading constrained model was acceptable ( $S-B\chi^2=304.8$ ,  $p<.001$ ,  $CFI=.914$ ,

RMSEA=.046) with minor and a nonsignificant level of deterioration overall in GOF from configurally invariant Model 5a ( $\Delta S-B\chi^2=14.9$ ,  $df=15$ ,  $p=.455$ ). Review of the 15 factor loadings indicated none significantly different at  $p<.01$  and only one factor significantly different at  $p<.05$  (CF-3,  $p=.030$ : ‘Building a fire ring if one is not present’). Next we examined Model 6 with constraints imposed on all second order paths ( $N=3$ ) as well as all first order paths ( $N=12$ ) less those fixed to one for identification purposes (of which there were three, one to identify each 1<sup>st</sup> order latent factor). None of the constrained parameters were significantly different ( $p>.05$ ), GOF was within acceptable bounds ( $S-B\chi^2=305.0$ ,  $p<.001$ , CFI=.914, RMSEA=.046), and a  $S-B\chi^2$ =difference test indicated no significant deterioration in model fit from configurally invariant Model 6 ( $\Delta S-B\chi^2=9.5$ ,  $df=15$ ,  $p=.850$ ). Thus, we conclude our hypothesized model is invariant at both the configural and metric levels.

### *Construct Validity*

The term ‘construct validity’ is recognized to subsume all types of validity testing. Specifically, validity types are frequently categorized into classifications including content, convergent, face, and criterion (prediction) validity (Anastasi & Urbina, 1998).

Addressing *content validity* asks if each item is related to the construct of interest and if the items selected are an accurate representation from the universe of potential items (Anastasi & Urbina, 1998; DeVellis, 2003). Assurances of content validity can be facilitated via the utilization of theory and/or conceptual frameworks, literature reviews,

cognitive interviews, and experts in the field assisting with item development (Anastasi & Urbina, 1998; DeVellis, 2003).

*Convergent validity* can be demonstrated via high correlations amongst scores. While a specific statistical test of convergent validity is nonexistent, the use of CFA procedures does allow insight into the convergent validity of a measure. Specifically, Anderson and Gerbing (1988) put forth that convergent validity can be demonstrated if paths to a higher order factor are statistically significant and of sufficient magnitude. Both samples exhibit high levels of convergent validity as demonstrated through the large ( $>.80$ ) 2<sup>nd</sup> order factor loadings (Table 3.4). Additionally, convergent validity can be assessed by examining the composite reliability of indicators. In this light, composite reliability is analogous to the reliability of a composite measure.

*Face validity* asks ‘does the test and do the items appear valid to those who take it and to experts in the field (i.e. does it make sense on the face)’ (Anastasi & Urbina, 1998). There is not a ‘measure’ or coefficient to report with face validity. Instead, we attempted to make assurances of face validity of the BCVES-V1 by aligning the measure with past efforts, having experts provide commentary on the developing measure, and employing the cognitive interviewing process with a subsample from the population of interest.

*Criterion (predictive) validity* addresses how well a test does at predicting an outcome later, the classic example being SAT scores predicting college achievement. Criterion validity is also known as the ‘gold standard’ because of the difficulty in assessing (DeVellis, 2003). Other terms synonymous with criterion validity include concurrent and

predictive validity. In the present case, we would expect both first order factors and the higher-order factor to be positively correlated to actual behaviors in backcountry environments. Determination of the criterion validity of the BCVES-V1 will only be able to be determined through future employment of this measure against behaviors or behavioral intentions of individuals regarding compliance with recommended LNT principles.

### *Reliability*

DeVellis defined the reliability coefficient (alpha) as “an indication of the proportion of variance in the scales score that is attributable to the true score” (2003, p. 94). As discussed by Thompson however, reliability is “only a necessary – not a sufficient – condition for validity (2004, p. 4). Additionally, a high reliability coefficient simply indicates high correlations between observed variables measuring a latent construct of interest and says *nothing* regarding coverage of the domain of interest (Little, Lindenberger, & Nesselroade, 1999). Thus, scale developers are advised to proceed judiciously with item removal so as to not sacrifice content validity for an increase in alpha. The overall Cronbach’s alpha for the ONP data in the 2<sup>nd</sup> order model was .801. For the GNP sample, the Cronbach’s alpha with the same factor structure (2<sup>nd</sup> order) was .768. See Table 3.5 for alpha values for each first order construct.

Table 3.5  
*Measurement Model (#5a) Standardized Loadings, Alpha, and Composite Reliabilities*

Latent Construct	Item	ONP			GNP		
		$\lambda$	$\alpha$	CR	$\lambda$	$\alpha$	CR
F1 - General Backcountry Attitude	TC-1	.41			.47		
	TC-3	.58			.59		
	TC-4	.48			.48		
	TC-6	.40			.36		
	TC-8	.36			.39		
	CL-1	.42			.43		
	CL-2	.38			.39		
			.60	.62		.63	.63
F2 - Disposal of Waste Attitude	DW-1	.39			.34		
	DW-2	.48			.43		
	DW-3	.53			.51		
	DW-4	.36			.39		
			.42	.49		.41	.46
F3 - Campfire Attitude	CF-1	.84			.78		
	CF-2	.85			.79		
	CF-3	.54			.36		
	CF-4	.55			.36		
			.77	.80		.63	.68

*Note.*  $\lambda$  = standardized factor loading;  $\alpha$ =scale alpha; CR=composite reliability; all factor loadings significant ( $p < .01$ )

## Discussion

Protected area managers prefer education over enforcement to influence human behaviors (Douchette & Cole, 1993). Furthermore, in the environmental behavior realm, attitude is regarded as a stronger determinant of behavior than knowledge (Pooley & O'Connor, 2000; Tarrant & Green, 1999). Our review of literature highlighted the absence of a scale to assess salient attitudes regarding common backcountry practices. To meet this recognized gap, we undertook a systematic effort to develop and empirically evaluate a measure to accurately assess backcountry attitudes. The resultant scale,

termed the WES – V1 (Backcountry Visitor Ethics Scale – Version 1) is, in our assessment, a psychometrically sound tool for determining attitudes regarding various backcountry camping practices amongst the populations sampled.

Several strengths of the current research deserve note. The development of the scale conformed closely with widely accepted development procedures ( DeVellis, 2003; Noar, 2003). The use of a guiding conceptual framework provided a basis for item generation and development and hypothesis testing and is a recommended step for all scale development (DeVellis, 2003). The employment of an expert panel during the item generation phase sparked a spirited dialog and resulted in the addition of 17 items to the item pool. The cognitive interviewing process conducted on-site at one of the study locations with individuals from the population of interest provided additional assurance as to the quality of our items as well as identifying potential problems not elucidated in the pilot testing phase. A CFA data analysis strategy, even though employed in an ‘exploratory’ manner, provided many statistical ‘tools’ for assessing competing models and guided item selection. The use of a separate independent sample from a second NPS unit provided additional assurances regarding the ability of the BCVES-V1 to transcend geographic boundaries to accurately assess backcountry ethics. Further, all tests of MI indicated that the test operates equivalently across samples.

Goodness-of-fit for the three-factor correlated variables model (Model #5a & 5b) and the 2<sup>nd</sup> order model (Model #6) was admissible in both samples. Similar to the decision criteria discussed by Noar (2003), theoretical considerations, parsimony, and empirical fit were all considered in arriving at the final measurement models. Prior to



post-hoc model modifications we considered both substantive theoretical and empirical findings before respecification of the model structure (Byrne, 2006). The resultant product appears to tap three different dimensions of what we have termed a LNT ethic.

Additionally, analysis indicates that the BCVES-V1, structured as a 2<sup>nd</sup> order factor, is empirically justifiable and preferable according to the parsimony principle. This has important implications for both theory and practice. Theoretically, this finding indicates that respondents view LNT as an interconnected program; each principle of the framework is not viewed as drastically different or inconsistent with other principles. From a practical standpoint, this finding suggests dissemination of the message does not need to be presented as individual components; rather the various LNT principles (travel and camping practices, disposal of waste, minimization of campfire impacts, etc.) can be presented as interconnected parts of the LNT wheel.

Several limitations need to be recognized so they may be addressed in future research efforts. The framework that guided development of items was conceptual in nature and was drawn from the LNT education principles in their present form. These principles were organized via many years of concerted effort by LNT, Inc., the National Outdoor Leadership School, recreation ecologists, and others (see Marion & Reid, 2001). This differs from a theoretical framework, which, by definition, has evolved through empirical means. Our findings suggested that respondents do not differentiate (attitudinally) between ‘travel and camp on durable surfaces’ (LNT #2) and LNT principles #5 & #6 (‘respect for other visitors’ and ‘respect for what is found’). Future efforts to assess the congruency between backcountry attitudes and the LNT principles

should consider developing and testing additional items, which may more fully encapsulate LNT principles #5 & #6 to further test if the perfect correlation continues.

Development of quality items is both a science and an art. Future efforts to extend and improve the BCVES-V1 should look to evaluate other, perhaps more germane items to include in future scales. As evident in Table 3.4, in Model 5b, the 1<sup>st</sup> order factor loadings for four items are on the low side ( $<.40$ ) of what is commonly accepted, even in exploratory analyses (Hatcher, 1994). This could be attributed to any number of reasons including poorly written items or socially desirable answering by survey respondents. However, these lower factor loadings could also be indicative of a broad operational definition for the constructs of interest. Thus, these could be ‘bad’ indicators which are, in actuality, ‘good’ (Little, et al., 1999). The two items exploring ‘respect for wildlife’ (LNT principle #7) solicited minimal variation from respondents (see Table 3.1), a fact likely attributable to several reasons. It is conceivable that all respondents strongly agree that ‘feeding wildlife’ and ‘dropping food on the ground to provide wildlife a food source’ are truly inappropriate backcountry behaviors. It is also plausible that these items solicited socially desirable responses. Future efforts to extend the BCVES-V1 are advised to develop alternative items to address the concept of human-wildlife attitudes.

Future research could also look to link salient backcountry attitudes (as measured via the BCVES-V1 or a subsequent version) to actual on ground behavior, thus addressing the criterion validity of the instrument. Do attitudes drive behaviors in backcountry contexts and if so to what extent? How effective are various education

strategies and which are the most effective in modifying existing attitudes and subsequent behaviors?

## Conclusion

Managing recreation use of backcountry environments has been and will continue to be a significant task for backcountry managers. However, additional understanding of salient attitudes regarding common backcountry practices can assist with developing educational interventions to address behavior. While the current study is limited to the context investigated (NPS overnight backcountry visitors in two parks), the BCVES-V1 appears to be a valid psychometrically sound measure of backcountry visitors' attitudes regarding promoted LNT Practices and is a substantive inroad into the assessment of attitudes regarding common backcountry practices. We envision this scale to be useful to a plethora of potential users, including backcountry managers, academics and graduate students, as well as other land managers managing environments that provide overnight backcountry experiences. Park and protected area managers and others interested in designing, developing, and promoting LNT educational efforts could use the BCVES-V1 to assess salient attitudes amongst human powered backcountry visitors as a starting point for such efforts. In addition, information obtained via the BCVES-V1 can be used to track long-term trends regarding overnight backcountry visitors' salient attitudes. Of course, with all measures and all bodies of knowledge, this is an initial inroad to be extended by others.

## Directions for Use of the BCVES-V1

To utilize the BCVES-V1 to assess backcountry visitor attitudes, administer the scale to a sample drawn from the population of interest. Care should be taken to follow recommended sample selection criteria to lessen instances of sampling bias. It is our recommendation that the seven-point scale using the ‘appropriateness’ anchors be used to anchor items in Table 3.1. Scores on each of the three subsections can be averaged to assess attitudes regarding specific LNT principles. Additionally, the three subsections can be weighted by the number of items averaged to create an overall ‘score’ for individuals. More advanced analyses could weight individual items prior to calculation of composite scores. For these two levels of analyses we recommend a sample size of approximately 200/250 individuals. For those interested in testing the psychometric qualities of the BCVES-V1 with CFA, 300 to 400 individual respondents are recommended.

## CHAPTER 4

### MANUSCRIPT #2: A STRUCTURAL MODEL FOR PREDICTING INTENTIONS TO COMPLY WITH LEAVE NO TRACE PRACTICES

Intended outlet

Leisure Sciences (article < 9,000 words)

Abstract

Leave No Trace (LNT) is an education program designed to promote ethical minimum-impact recreation and camping behaviors in backcountry settings. The program was officially adopted by the US National Park Service (NPS) in 1993, yet there is limited knowledge regarding the effectiveness of the program and the determinants of compliance. To meet this end, an extended version of the Theory of Planned Behavior (TPB) was operationalized and empirically evaluated using structural equation modeling to gauge the theory's effectiveness in predicting behavioral intentions to comply with promoted LNT guidelines. Primary data were collected in the summer 2007 via a mail-back questionnaire from overnight backcountry users in two NPS Units: Olympic National Park, WA (N=313) and Glacier National Park, MT (N=279). Results indicate the model can explain as much as 44.3% of the variance in intentions to comply with promoted practices; however, significant predictors of intentions vary by unit. Discussion regarding the various determinants of intentions to comply with

recommended LNT practices is provided as well as advice and guidance for those charged with dissemination of the LNT message in protected area contexts.

#### Keywords

theory of planned behavior, leave no trace, LNT, visitor education, structural equation modeling

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## Introduction & Purpose

Visitor education is an important tool for park and protected area management (Hendee, et al., 1990). Educational frameworks such as Leave No Trace, Codes of Conduct and others provide mechanisms for lessening visitor induced impacts while protecting the quality of the experience (Marion & Reid, 2001, 2007). While specific messages vary between educational strategies, education can provide managers tactics to promote conservation/stewardship behaviors (Hendee, et al., 1990; Roggenbuck & Berrier, 1982), raise awareness (Ballantyne & Uzzell, 1999), lessen instances of depreciative behavior (Kimmel, 1999), increase knowledge (Cole, et al., 1997), influence attitudes (Powell & Ham, 2008), and enhance the experience (Ham, 1992). Indeed, research has shown education to be preferred by both managers (Washburne & Cole, 1983) and visitors (Hendee, et al., 1990) in protected area contexts over more direct methods such as sanctions or regulations.

The most pervasive visitor education strategy used in protected area contexts is Leave No Trace (LNT), an educational initiative designed to lessen the impacts of backcountry recreationists upon the landscape. The LNT principles are recognized as having evolved from early US Forest Service initiatives to where they are today, a set of seven ‘best practices’ derived from the field of recreation ecology (Marion & Reid, 2001). The message was formally adopted in 1993 by the four primary federal land management agencies ([www.lnt.org](http://www.lnt.org)). However, despite the extensive use of LNT across the National Park Service (NPS) and in other protected area contexts, little research has investigated the effectiveness of the program in influencing behaviors and the

determinants of compliance (Marion & Reid, 2001; Miller, et al., 2001; Roggenbuck, 1992).

There were two main purposes for this study. First, using structural equation modeling (SEM), we assessed the structural viability of the Theory of Planned Behavior (TPB) (Ajzen, 1991) for predicting intentions to comply with recommended LNT principles with two independent samples. Substantiation and cross-validation of a behavioral change model such as the TPB can potentially assist in the development of more effective educational messages through the illumination of salient predictor variables upon which future educational messages can be targeted. Secondly, this study examined the feasibility of extending the TPB to include the variable self-reported knowledge of LNT principles. Extending the TPB to increase predictability of the model is a growing trend in the literature; however, the use of the knowledge variable in this context is new.

## Literature Review

### *Visitor Management Strategies*

The NPS and other protected area land managers face a plethora of diverse and difficult challenges stemming from both within and outside their borders. In trying to manage for long-term sustainability of the resource while providing for visitor enjoyment, managers balance competing recreational demands, increasing visitation, shrinking budgets, and improper human behavior amongst other challenges (Potts, 2007). A growing body of literature suggests that understanding people and the issues they



present is imperative (Ewert, 1995). There are two primary methods for addressing recreational impacts in backcountry settings; direct (hard or regulatory) and indirect (soft or nonregulatory) (Peterson & Lime, 1979). Direct visitor management strategies characteristically include regulations, sanctions, and/or physical management such as barriers, boardwalks, and/or fencing (Manning, 1999). Conversely, indirect visitor management strategies typically include the use of education to influence behaviors in a direction deemed appropriate by management. As discussed by Manning (1999), indirect management strategies including education are generally preferred in backcountry contexts as research has shown they enhance the visitor experience, require fewer resources than enforcement, and are more in-line with the spirit of the Wilderness Act (see also Hendee, et al., 1990; McCool & Christensen, 1996).

At the foundation of effective backcountry visitor management is an education/communication strategy that consistently reaches specific and predetermined outcomes (Ham & Krumpal, 1996). Thus, education can be viewed as a persuasion tool to better meet management objectives. Within the realm of backcountry recreation management, the outcomes that managers frequently desire to change include attitudes, knowledge, and/or behavior. Attitudes have been defined as the “psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (Eagly & Chaiken, 1993, p. 1). Knowledge refers to information we possess, or ‘what we know.’ Behavior is an umbrella term encompassing any number of actions; in protected area contexts, behaviors of interest likely include interactions with wildlife, camping

practices, and the use of campfire amongst others. As will be discussed in the subsequent section, LNT is designed to fill this gap.

### *Leave No Trace*

Leave No Trace (LNT) is an educational message designed to educate the recreating public regarding ethical minimum-impact camping practices, with the end goal the protection of resources (Harmon, 1997; Marion & Reid, 2001). The foundation of the LNT program can be traced back to the 1960s when the US Forest Service began to encourage ‘pack it in – pack it out’ messages to users. This fledgling effort was based in part on the success of the anti-forest fire campaign (Smoky Bear) and was aimed at reducing littering in backcountry. By the mid 1970s the effort had evolved to what are now considered early ‘minimum-impact camping’ messages. As backcountry recreation use increased through the 1980s, it became evident that a more comprehensive program was necessary to address impacts from backcountry recreationists. To meet this need, the US Forest Service teamed with the National Outdoor Leadership School (NOLS) and began to develop what are now known as the seven LNT principles (Marion & Reid, 2001), which was based on research by recreation ecologists (Cole, 1989, 1992; Hammitt & Cole, 1998; Hampton & Cole, 2003; Leung & Marion, 2000). In 1994, Leave No Trace was incorporated as a 501(c)3 nonprofit organization and named ‘The Leave No Trace Center for Outdoor Ethics’ (The Center). The Center’s mission is ‘dedicated to the responsible enjoyment and active stewardship of the outdoors by all people, worldwide’ ([www.lnt.org](http://www.lnt.org)). In 1994, The Center signed a Memorandum of Understanding (MOU) with the US Forest Service, Bureau of Land Management, Fish & Wildlife Service, and

NPS to promote the LNT message on federal lands. This agreement officially designated LNT as the primary visitor education tool for mitigating human-powered recreationists' impact on federal lands. Figure 4.1 displays the current practices:

- Leave No Trace Principles (www.lnt.org)
1. Plan ahead and prepare
  2. Camp and travel on durable surfaces
  3. Dispose of waste properly
  4. Minimize campfire impacts
  5. Be considerate of other visitors
  6. Leave what you find
  7. Respect wildlife

*Figure 4.1* Leave No Trace Principles

Research examining the efficacy of visitor education to influence human behaviors can be traced back to at least Fazio's (1979) study of camping practices at Rocky Mountain National Park. Investigations addressing the efficacy of LNT are however much less frequent within the literature and largely atheoretical, this despite the wide use of persuasion and communication theory in education research. This is in spite of the fact that various researchers have called for additional investigations of the program (Cole, 1998; Confer, et al., 1999; Wright, 1999). With that in mind, there are several studies of particular importance to this research. A report compiled by Miller, Borrie, and Harding (2001) provided a theoretical review of factors that may influence the practice of minimum-impact (i.e. LNT) behaviors. While not directly testing any of the theories reviewed, this research served to direct our theoretical orientation for the present investigation. Stubbs (1991) investigated objective knowledge of low-impact

practices (quiz) and the effectiveness of visitor education at lessening instances of visitor induced recreational impacts. Knowledge was found to be low, a result he surmised caused by changing agency recommendations regarding practices. Additionally, while a positive correlation was discovered between knowledge of proper campsite attributes and selection of actual campsites, the study was hindered by a small number of observations. Reuhrwein (1998) examined self-reported backcountry behaviors of recreationists through the lens of the Theory of Reasoned Action (Fishbein & Ajzen, 1975). However, Reuhrwein's study used single item measures of attitudes, which was the likely culprit for the weak to nonexistent (significant) correlations between primary study constructs. Thus, to the best of our knowledge, this is the first research to explicitly test a theoretical framework with a high level of statistical analysis with the goal of further understanding the drivers of compliance with LNT principles.

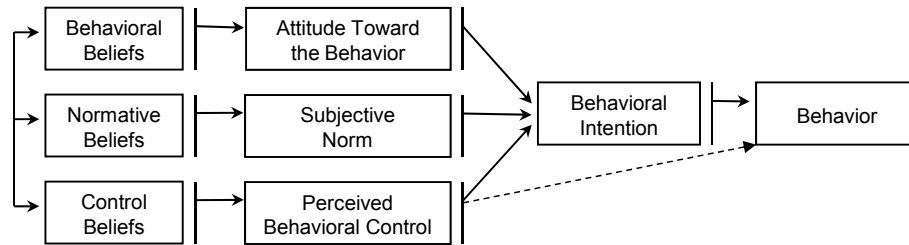
#### Theoretical Framework: The Theory of Planned Behavior

The utilization of theory can provide guidance for understanding phenomenon of interest by providing insight into the correct types and forms of questions and guide variable selection and operationalization of study constructs (Henderson, et al., 2004). Behavioral change theory can potentially identify determinants of human behavior through the illumination of pathways that may lead to the mechanisms we are most interested in influencing (Ham, 2007a). In this investigation, the Theory of Planned Behavior (TPB) (Ajzen, 1991), a behavioral change theory, was operationalized and empirically evaluated to investigate the drivers of compliance with promoted LNT

principles as well as to offer insight into the subsequent delivery of minimum-impact visitor education.

The Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) and its successor the TPB (Ajzen, 1991) are general theories of social psychology that examine the antecedents of human behavior. Taken together they are perhaps the two most widely utilized theories of social psychology (Armitage & Conner, 2001; Sheppard, et al., 1988). Francis et al. (2004), report that from 1985 through January 2004, over 600 published studies utilized the TPB. The theories contend that as rational actors, behavior is best predicted by an individual's behavioral intention (BI) to undertake said behavior. According to the TRA, BI is a product of the interaction of attitudes (AT) towards the behavioral outcome and the influence of social norms (SN), i.e. peer pressure (Fishbein & Ajzen, 1975). The TPB extends the TRA through the inclusion of a third construct, perceived behavioral control (PBC) (Ajzen, 1991, 2002), frequently likened to Bandura's theory of Self-Efficacy (Bandura, 1977). The construct was added in an attempt to create a predictive model that would capture behaviors of interest perceived to be outside an individual's complete volitional control (Ajzen, 1991). Eagly & Chaiken defined PBC as the belief an individual holds regarding "how easy or difficult it is to perform the behavior" (1993, pp. 186-187). Conner and Armitage (1998) described PBC as a 'continuum,' with behaviors completely under the control of the actor on one end and behaviors that are impossible to carry out on the other end. Underlying AT, SN, and (in the case of TPB) PBC constructs are what researchers term a core set of behavioral beliefs (Ajzen, 1991). Beliefs can be created or manipulated through direct experience or

from outside sources. Individuals constantly form and adjust beliefs about themselves, other people, products, behaviors, and institutions among others (Fishbein & Ajzen, 1975). Figure 4.2 displays the Theory of Planned Behavior.



*Figure 4.2 Theory of Planned Behavior*

The TPB has been routinely employed for research efforts exploring leisure/recreation behavior (Ajzen & Driver, 1991, 1992; Hrubes, Ajzen, & Daigle, 2001), conservation/pro-environmental behavior (Clark & Finley, 2007; Kaiser, Hubner, & Bogner, 2005; Lam, 2006; Oreg & Katz-Gerro, 2006) as well as natural resource management issues (Kaiser & Scheuthle, 2003; Nesbitt, 2006; Pouta & Rekola, 2001; Vogt, Winter, & Fried, 2005). The underlying value of the TPB lays in the relationships hypothesized to exist between determinants (AT, SN, PBC) and outcomes (behavior or BI). If one or more of the three determinants predict BI, BI determines behavior, and determinants can be influenced, then, in the context of LNT, protected area managers theoretically can use communication/education to direct visitors' behaviors in directions deemed appropriate.

Despite widespread use and relative success in predicting behavior (Armitage & Conner, 2001), the TPB is occasionally criticized regarding both the generic nature of the framework (Armitage & Conner, 1999b; Conner & Armitage, 1998) and the conceptualization and operationalization of the PBC construct (Conner & Armitage, 1998; Terry & O'Leary, 1995). Those in support of extending the model contend that the TPB explains, on average, 39% of the variance in behavioral intentions and 27% of the variance in behaviors, which leaves a significant amount of variation unexplained (Sutton, 1998). To address this potential shortcoming, other predictors have been added to the model to increase its predictive strength (Armitage & Conner, 1999b; Conner & Armitage, 1998; Kaiser, 2006; Kaiser & Scheuthle, 2003; Vogt, et al., 2005). In commenting on the extendibility of the framework, Ajzen states: “the TPB is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant portion of the variance in intention or behavior after the theory’s current variables have been taken into account” (1991, p. 199). Connor and Armitage explore this notion, cautioning however that ‘a theoretical description of the role of additional variables within the TPB is required if a theoretically coherent model is to result’ (1998, p. 1433).

A second criticism of TPB has addressed the conceptualization and operationalization of the PBC construct (Ajzen, 2002). Ajzen (2002) defined PBC as “the perceived ease or difficulty of performing the behavior” (p. 665), from which one could infer that the construct is composed of two parts: perceived control over performance of a behavior as well as perceived difficulty with carrying out a behavior of

interest. Despite this differentiation, a review of the literature illuminated wide variation in operationalization of the PBC construct. For instance, a number of past efforts employing TPB used either a unidimensional approach to capturing this construct or completely ignored the perceived difficulty component (Armitage & Conner, 1999a). However, Terry & O’Leary (1995) using a SEM approach, discovered perceived control and perceived difficulty provided a better fit when modeled independently rather than unidimensionally (see also Ajzen, 2002; Traifmow, et al., 2002). Not all researchers have agreed with this finding however. Chan and Cheng (1998) posited that the perceived difficulty construct is better represented as part of the attitudinal construct of TPB. Kraft, Rise, Sutton, & Roysamb (2005) corroborated Chan and Cheng’s findings and report that perceived difficulty items ‘overlapped substantially with affective attitude’ (pg. 479) and that the inclusion of the perceived difficulty construct causes the PBC (control) construct to be overestimated and the attitudinal construct to be underestimated. In conclusion, the PBC construct remains a point of uncertainty with TPB research (Ajzen, 2002).

#### *Knowledge of Leave No Trace Principles*

There is a long-held tenet that knowledge influences behavior. In the environmental realm, higher levels of environmental knowledge have been demonstrated empirically to be related to higher levels of environmental behaviors generally (Hines, Hungerford, & Tomera, 1986/87; Kaiser & Fuhrer, 2003) and recycling specifically (Vining & Ebreo, 1990). In a study of recycling behavior using the TPB, Cheung, Chan, & Wong (1999) discovered that even after controlling for core TPB variables, knowledge made a statistically significant contribution to the model. With this in mind, it is easy to



hypothesize how knowledge of LNT principles or the lack thereof, may influence backcountry visitors' behavior/behavioral intentions regarding recommended practices. For example, an individual may intend to minimize their harm to the environment yet may not know the correct practices to do so. Indeed, while various researchers have succeeded in demonstrating how education can be used to influence behavior in backcountry contexts, the majority of such studies have focused primarily on the use of information to redirect and disperse visitors (Huffman & Williams, 1987; Krumpe & Brown, 1982; Roggenbuck & Berrier, 1982). In a rare example, Dowell & McCool (1986) demonstrated that behavioral intentions can be affected by knowledge. However, effect of knowledge of LNT principles has never been examined while controlling from the three TPB constructs. Thus, this research looks to extend understanding of the role knowledge plays in predicting compliance with promoted LNT principles.

## Methods

### *Study Sites & Samples*

Two NPS units were selected for inclusion in this research: Glacier National Park (GNP), Montana and Olympic National Park (ONP), Washington. The two study locations were selected because both parks are large contiguous wilderness/de facto wilderness areas, are popular NPS backpacking destinations that attract thousands of overnight backcountry visitors annually, mandate backcountry permits for all overnight backcountry visitors, and require pre-trip check-ins immediately before the trip. The sample was selected by systematically intercepting individuals and groups upon their

arrival at the respective permit issuing stations in the two NPS Units. All adult group members were asked to participate in the study. Over 96% of those asked, agreed to participate and completed a contact card. Mail-back questionnaires were then sent following a modified tailored design method with multiple contacts (N=3) to increase response rate (Dillman, 2007). The adjusted response rate was 73% for ONP and 68% for GNP (N=312 & 279, respectively). A phone interview of non-respondents (N=30/unit) indicated no significant differences between groups on several key variables ( $p>.05$ ).

### *Measurement of Constructs*

Based upon the TPB (Ajzen, 1991), study constructs were operationalized following steps outlined by DeVellis (2003) including extensive pilot testing and cognitive interviewing (for more information see Powell, et al., 2008). All items, anchors, factor loadings, and univariate statistics are provided in Table 4.2. Behavioral intentions to follow minimum-impact guidelines were measured via three items on a seven-point Likert-type scale (1=Strongly Disagree, 4=Neutral, 7=Strongly Agree). To measure salient attitudes (F2) regarding various LNT practices, 11 items were utilized to examine three dimensions: attitudes towards travel and camping practices (F2a), attitudes towards waste management (F2b), and attitudes towards campfires (F2c). A previous investigation using confirmatory factor analysis (CFA) to develop a multidimensional measurement model of LNT attitudes elucidated that attitudes can be accounted for by a second-order factor; a factor was termed 'LNT Ethic' by the researchers (Vagias, Powell, & Moore, in-development). Therefore, the attitudinal component of TPB was structured

as a second-order factor with the three first-order factors reflective of the hypothesized single 'LNT Ethic' second-order factor (see Figure 4.2 for a visual representation of the structure). The influence of subjective norms (SN) was assessed via two items using a seven-point scale (+1 to +7) anchored by strongly disagree – strongly agree. Perceived Behavioral Control-Perceived Control (PBC-PC) was evaluated via three items on a seven-point scale using the anchors 1=not at all under my control, 4=neutral, 7=completely under my control. Consistent with Traifmow et al. (2002), perceived difficulty (PBC-PD) assessed via three items anchored on a seven-point scale ranging from very difficult (1) to neutral (4) to very easy (7). Perceived knowledge of LNT practices was evaluated via a single question based upon a seven point scale ranging from 0=no knowledge to 6=expert.

#### *Data Screening & Imputation*

All initial data screening and imputation procedures were conducted independently to avoid cross-sample contamination. Four cases from ONP and one case from GNP were missing over 50% of data on study variables and were eliminated from further analyses. There were no univariate outliers. Regression-based screening procedures indicated the presence of one multivariate outlier in each of the respective datasets and these cases were removed from further analyses (Fox, 1991; Tabachnick & Fidell, 2007). Approximately .9% and 1.4% of total data points were missing for the ONP and GNP samples, respectively. A missing data analysis was conducted using EQS 6.1 (Bentler, 2005) to examine if significant patterns of missingness existed. Test results concerning the homogeneity of covariance matrices indicated the pattern of missing data

could be considered missing completely at random (aka MCAR) for both the ONP sample ( $N=291$ ,  $\chi^2=1182.7$ ,  $df=1496$ ,  $p=1.000$ ) as well as the GNP sample ( $N=265$ ,  $\chi^2=1573.5$ ,  $df=2333$ ,  $p=1.000$ ) (Allison, 2003). Note, the degrees of freedom are larger than the  $\chi^2$  resulting in the p-value of one. Primary study data were imputed via EQS v6.1 using an expectation maximization (EM) imputation procedure. Post-imputation, final data screening procedures indicated four cases from ONP and six cases from GNP possessed multivariate kurtosis levels clearly discrepant and these cases were subsequently eliminated from further analyses. The removal of all outlying and multivariate abnormal cases represented less than 2% and 3% of total cases for the ONP and GNP samples, respectively.

## Results

### *Sample Characteristics*

Table 4.1 contains demographic characteristics by NPS unit. Approximately six out of ten respondents were male in both samples. The average age of ONP respondents was 41.4 years, five years older than their GNP counterparts at 36.2 years ( $p<.05$ ). Both samples were primarily white and highly educated with greater than 90% of respondents having at least a college education. ONP respondents have engaged in overnight backcountry camping, on average, for 21.6 years ( $SD=14.5$ ) while GNP respondents averaged 13.4 years ( $SD=11.9$ ).

Table 4.1

*Demographic Profile of Respondents*

Profile Variable		Olympic National Park		Glacier National Park	
		N	%	N	%
Gender	Male	184	60.3	169	63.1
	Female	121	39.7	99	36.9
Age Range	29 or younger	68	22.4	116	43.4
	30 - 39	70	23.1	56	21.0
	40 - 49	69	22.8	45	16.9
	50 - 59	77	25.4	40	15.0
	60 - 69	18	5.9	10	3.7
	70 or older	1	0.3	0	0.0
	<i>Mean age for unit</i>	41.4		36.2	
Race	White, Not of Hispanic Descent	281	96.9	257	98.5
	Black, not of Hispanic Descent	0	0.0	0	0.0
	Hispanic	2	0.7	1	0.4
	Asian or Pacific Islander	7	2.4	2	0.8
	American Indian or Pacific Islander	0	0.0	1	0.4
Education	Less than high school	1	0.3	5	1.9
	High school	10	3.3	20	7.5
	College	138	45.5	136	50.9
	Graduate study	154	50.8	106	39.7
Total Household Income (2006)	Less than \$20,000	19	6.6	26	10.0
	\$20,000 - \$39,999	30	10.4	46	17.8
	\$40,000 - \$59,999	49	17.0	52	20.1
	\$60,000 - \$79,999	48	16.6	43	16.6
	\$80,000 - \$99,999	46	15.9	38	14.7
	Greater than \$100,000	97	33.6	54	20.8

*Descriptive Statistics of Variables*

All structural regression model variables and latent constructs are presented in Table 4.2. Latent variables are italicized in bold type while observed variables are in normal typeface.

Table 4.2  
Summary Statistics for Observed Variables (Items) and Latent Factors (Constructs)

Primary Study Constructs (abbreviation) First-order factors		Olympic National Park			Glacier National Park		
ID	Indicators	$\lambda$	M	SD	$\lambda$	M	SD
F1	<b>Behavioral Intentions (BI)</b> <sup>a f</sup>						
BI-1	I intended to follow recommended minimum-impact practices during my backcountry trip in XNP.	.626	6.62	.70	.640	6.67	.62
BI-2	I made every effort to follow XNP recommended minimum-impact practices.	.701	6.33	.88	.778	6.57	.61
BI-3	I was determined to follow recommended minimum-impact practices during my backcountry trip in XNP.	.867	6.14	.99	.720	6.42	.76
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.764			.748		
F2	<b>Attitude (AT)</b> <sup>b</sup>						
F2a	<i>Attitude re: General Backcountry Behaviors</i>						
A-1	Camping along the edge of a stream or lake	.537	3.78	1.92	.645	4.21	1.90
A-2	When camping in heavily used areas, placing the tent in an undisturbed spot	.413	2.06	1.36	.338	2.14	1.55
A-3	Camping two nights in a pristine camp	.370	4.67	1.80	.414	4.90	1.70
A-4	Camping with large groups (8 or more people) in the backcountry	.414	2.99	1.60	.421	3.10	1.65
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.500			.518		
F2b	<i>Attitude re: Waste Management</i>						
A-5	Burying used toilet paper	.397	4.46	2.12	.259	4.17	2.21
A-6	Using soap in streams as long as there are currents to help dilute the suds	.520	1.95	1.31	.608	1.89	1.24
A-7	Depositing human waste on top of the ground so it will decompose quickly	.320	1.58	1.10	.381	1.55	1.12
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.340			.284		
F2c	<i>Attitude re: Campfire</i>						
A-8	Having a campfire	.853	4.10	1.83	.750	4.15	1.65
A-9	Cooking over a fire in the backcountry	.843	3.74	1.90	.799	3.85	1.84
A-10	Building a fire ring if one is not present	.542	2.81	2.04	.358	2.41	1.92
A-11	Leaving charred wood contained in the fire ring	.536	4.13	1.90	.382	3.87	1.86
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.772			.627		
	<i>Overall Cronbach's Alpha (Scale <math>\alpha</math>)</i>	.767			.715		
F3	<b>Subjective Norms (SN)</b> <sup>a</sup>						
SN-1	Other members of my backcountry group would find it acceptable for me to bathe in a stream or lake.	.513	4.26	1.94	.641	3.88	2.03
SN-2	Other members of my backcountry party would approve of me moving a few rocks or logs around to make camp more comfortable	.675	4.97	1.57	.738	3.96	1.78
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.506			.655		
F4	<b>Perceived Behavioral Control; Perceived Control (PBC-PC)</b> <sup>c f</sup>						
PC-1	How I act while in the backcountry of XNP is...	.953	6.57	.65	.976	6.44	.84
PC-2	The way I act in the backcountry of XNP is...	.993	6.60	.62	.974	6.47	.80
PC-3	My backcountry camping practices in XNP are...	.579	6.43	.83	.263	6.18	1.27
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.843			.659		
F5	<b>Perceived Behavioral Control; Perceived Difficulty (PBC-PD)</b> <sup>d f</sup>						
PD-1	If I wanted to, carrying all of my litter out of the backcountry of XNP would be:	.432	6.52	.91	.681	6.55	.77
PD-2	Depositing my human waste in a small hole in the soil:	.645	6.36	1.03	.446	6.10	1.25
PD-3	I find following XNP recommended minimum-impact/LNT camping guidelines to be:	.731	6.00	.95	.594	6.16	.83
	<i>Cronbach's Alpha (<math>\alpha</math>)</i>	.625			.552		
Know	<b>Perceived Knowledge of LNT Practices</b> <sup>e f</sup>						
	How would you describe your current knowledge of LNT Practices?	--	3.97	.92	--	4.20	.85

<sup>a</sup> Based on a 7 point scale; 1=strongly disagree, 4=neutral, 7=strongly agree.

<sup>b</sup> Based on a 7 point scale; 1=very inappropriate, 4=neutral, 7=very appropriate. Lower score reflects stronger compliance

<sup>c</sup> Based on a 7 point scale; 1=not at all under my control, 4=neutral, 7=completely under my control.

<sup>d</sup> Based on a 7 point scale; 1=very difficult, 4=neutral, 7=very easy.

<sup>e</sup> Based on 7 point scale; 0=no knowledge, 1=very limited, 2=limited, 3=average, 4=above average, 5=extensive, 6=expert.

<sup>f</sup> Reverse coded before entry into structural regression model.

### *Configural Measurement Model*

A structural equation modeling (SEM) approach was employed using the EQS V6.1 software package (Bentler, 2005) and maximum likelihood estimation technique. There are numerous advantages to utilizing SEM over more traditional multiple regression data analysis strategies including the development of a satisfactory measurement model prior to regression estimation, the availability of goodness-of-fit (GOF) statistics for which to assess model quality, and the ability to model true score of the latent variable(s) (Kline, 2005). More specifically regarding GOF, SEM based analyses provided a number fit statistics that provide insight into the appropriateness of the specified model. However, there is not a single 'global' measure of fit, instead researchers are encouraged to report multiple measures that, when taken together, provide greater insight into model quality (Kline, 2005). Consistent with this advice, we report multiple measures of fit including; Chi-square ( $\chi^2$ ), Satorra-Bentler Scaled Chi-Square (S-B $\chi^2$ ), Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR) and the Root Mean Square Error of Approximation (RMSEA) and its associated 90% confidence interval (RMSEA CI). The  $\chi^2$  statistic provides a measure of 'misfit' between the covariance structure of the researchers' hypothesized model and the observed covariance matrix with p-values of less than ( $<$ ) .05 indicative of poor model fit. However, with large samples it is likely that a significant model chi-square will be obtained even if the model fits the observed data well (Byrne, 2006; Tabachnick & Fidell, 2007). Mardia's normalized estimate indicated the presence of nonnormality within both datasets (ONP= 22.5, GNP=16.8), a fact not uncommon in behavioral and social research

(Micceri, 1989). Consequently, we report robust estimates for CFI and RMSEA and the  $S-B\chi^2$  as these statistics are more suitable for data exhibiting signs of nonnormality (Byrne, 2006; Satorra, 1992; Satorra & Bentler, 1994). The CFI is an incremental fit index less susceptible to sample size than other similar measures such as Normed Fit Index (Kline, 2005). The index is based on scale of 0 to 1 with values greater than .90 indicating an acceptable fit and values greater than .95 indicative of an excellent fit to the data (Hu & Bentler, 1998). The RMSEA is based on the analysis of residuals in the model with acceptable values from .05 to .08 and values  $<.05$  considered excellent (Browne, 1982; Steiger, 1988). Finally, the SRMR provides an indication of differences between the observed and predicted covariances with a value of less than .10 considered acceptable (Kline, 2005).

The two-step SEM procedure outlined by Anderson & Gerbing (1988) was used in this study. Step one involved the development of a configural measurement model. Development of an acceptable measurement model, while not a test of a ‘true model’ (such a test is impossible), does provide insight into the relationships amongst variables through empirical assessment of misfit, both cross-loadings (variables across factors) and correlated error terms. Further, the acceptance of a measurement model that meets established GOF criteria provides researchers an indication of the soundness of the latent variables and is thus a key component for demonstrating validity (Anderson & Gerbing, 1988; Kline, 2005). The Lagrange Multiplier (LM) Test was used during initial measurement model building to explore areas of ‘misfit,’ i.e. parameters, which if freed, would significantly improve overall model fit. Care must be exercised however in



considering the theoretical soundness of each modification indicated by the LM test (Byrne, 2006). This is due to the fact that the LM test is completely empirical and statistical improvements must not supersede theoretical criteria (Tabachnick & Fidell, 2007). Following arrival at an admissible measurement model, a separate independent sample was used to cross-validate the measurement model. Step two involved estimating structural regression models to ascertain effect sizes between study constructs and the overall portion of variance explained by each model.

The configural measurement model was created using the ONP data, as it was less homogenous than the ONP sample. Model construction was incremental with each TPB construct specified to be comprised of multiple indicators and the structure was (dis)confirmed via CFA. Goodness-of-fit statistics for both samples are presented in Table 4.3 and first-order latent variable correlations are presented in Table 4.4. The initial measurement model was empirically supported ( $CFI=.940$ ,  $RMSEA=.043$ ). One cross-loading was identified by the LM Test as providing a significant reduction in the chi-square value; a cross-loading between item ‘having a campfire’ (Item A-8) and Attitude Factor ‘General Backcountry Behaviors’ (F2-a). Freely estimating this cross-loading provided a statistically significant improvement in model fit ( $\Delta S-B\chi^2=14.9$ ,  $df=1$ ,  $p=.000$ ,  $\Delta CFI=.006$ ), calculated using the S-B $\chi^2$  difference test (Crawford & Henry, 2003; Satorra & Bentler, 2001). Model 1b in Table 4.3 was the final configural measurement model.

### *Construct Validity of the Measurement Model*

Assessing the validity of a test provides insight as to how well it fulfills its purported function (Anastasi & Urbina, 1998). The ability to cross-validate a measurement model with a separate independent sample provides strong evidence of the theoretical soundness of the hypothesized model and is thus an initial step for demonstrating construct validity.

Table 4.3

*Summary of Goodness-of-Fit (GOF) Statistics for Measurement Models*

<i>Model</i>	<i>Unit</i>	Goodness-of-Fit Statistics						
		$\chi^2$	$S-B\chi^2$	<i>df</i>	<i>p</i>	<i>CFI</i>	<i>SRMR</i>	<i>RMSEA (90% CI)</i>
1a	ONP	327.4	314.8	203	.000	.940	.056	.043 (.033, .051)
	GNP	288.1	277.0	203	.000	.952	.052	.037 (.025, .047)
1b	ONP <sup>a</sup>	316.6	302.8	202	.000	.946	.056	.041 (.031, .050)
	GNP <sup>b</sup>	271.4	260.5	202	.003	.962	.051	.033 (.020, .044)

<sup>a</sup> cross-loading modeled between F2-a and observed variable A-8

<sup>b</sup> error covariance modeled between observed variables A-4 and A-8

The GNP data was fit to the ONP configural measurement Model 1a (Table 4.3). Results supported the hypothesized structure as an accurate representation of the factor structure ( $CFI=.952$ ,  $RMSEA=.037$ ). A review of the LM Test results indicated that freely estimating the error covariance between items ‘camping with large groups (8 or more people) in the backcountry’ (A-4) and ‘having a campfire’ (A-8) would significantly improve model fit. After freeing this parameter, a chi-square difference test indicated a significant improvement in the fit of the model ( $\Delta S-B\chi^2=27.3$ ,  $df=1$ ,  $p<.001$ ,

$\Delta CFI=.010$ ). Model 1b likewise exhibited satisfactory fit properties ( $CFI=.962$ ,  $RMSEA=.033$ ) and was the final measurement model specified.

Table 4.4

*Bivariate Correlations of the Latent Constructs (ONP N=305, GNP N=271)*

<i>ONP</i> <sup>a</sup>	BI (F1)	AT (F2a)	AT (F2b)	AT (F2c)	SN (F3)	PC (F4)	PD (F5)	Knowledge
BI (F1)	1.000							
AT (F2a)	.118	1.000						
AT (F2b)	*.281	*.791	1.000					
AT (F2c)	.090	*.897	*.673	1.000				
SN (F3)	.149	*.516	*.536	*.443	1.000			
PBC-PC (F4)	*.192	-.087	.066	*.110	.132	1.000		
PBC-PD (F5)	*.520	*.275	*.542	*.216	*.348	*.290	1.000	
Knowledge	*.280	*.314	*.234	*.254	.064	*.136	*.362	1.000

<i>GNP</i> <sup>b</sup>	BI (F1)	AT (F2a)	AT (F2b)	AT (F2c)	SN (F3)	PC (F4)	PD (F5)	Knowledge
BI (F1)	1.000							
AT (F2a)	*.397	1.000						
AT (F2b)	*.535	*.688	1.000					
AT (F2c)	*.259	*.880	*.487	1.000				
SN (F3)	*.377	*.324	*.589	*.397	1.000			
PBC-PC (F4)	.126	-.143	.081	.013	*.157	1.000		
PBC-PD (F5)	*.510	*.280	*.458	*.371	*.357	*.312	1.000	
Knowledge	*.459	*.227	*.224	.055	.064	-.035	*.225	1.000

<sup>a</sup> Includes cross-load between F2a and observed variable A-8

<sup>b</sup> Includes error covariance between observed variables A-4 and A-8

\* Significant  $p < .05$

### *Measurement Invariance of the Measurement Model*

Another approach to assessing validity addresses measurement invariance (MI); examining if statistically equivalent factor structure exists across samples (configural invariance) and examining if factor loadings are equivalent (again statistically) across samples (metric invariance) (Kline, 2005; Vandenberg & Lance, 2000). To assess

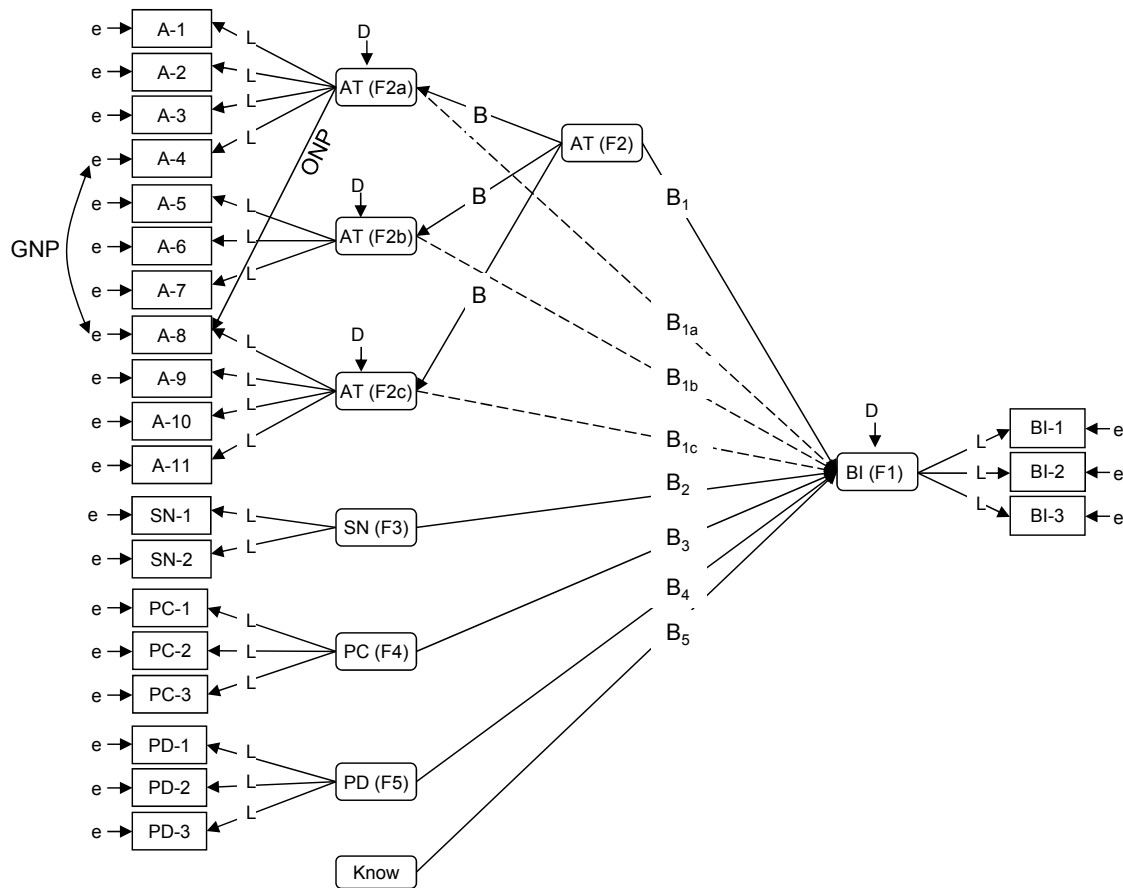
configural invariance, measurement model #1a was specified as a multi-group model and fit assessed by running both datasets simultaneously. Note that consistent with Byrne (2006), neither the error covariance for GNP nor the cross-loading for ONP were modeled as these were unique to each sample. Results indicate that the two models are configurally invariant ( $\chi^2=615.5$ ,  $S-B\chi^2=591.7$ ,  $df=406$ ,  $CFI=.946$ ,  $SRMR=.054$ ,  $RMSEA=.040$ ).

The second step for demonstrating MI involves assessing metric invariance; i.e. equality of factor loadings across groups (Vandenberg & Lance, 2000). As discussed by Byrne (2006), metric invariance is assessed through adequacy of GOF statistics and limited model degradation from the configural model when factor loadings are constrained to be equal between groups (see also Widaman & Reise, 1997). To ascertain the extent of metric invariance, Model #1a was specified with equality constraints imposed on all factor loadings (22 constraints) and both datasets run simultaneously. Alpha was set at .01 to lessen instances of making a type one error. Fit was within acceptable bounds ( $\chi^2=687.0$ ,  $S-B\chi^2=654.1$ ,  $df=428$ ,  $CFI=.934$ ,  $SRMR=.069$ ,  $RMSEA=.043$ ), however a  $S-B\chi^2$  difference test indicated a significant deterioration in model GOF ( $\Delta S-B\chi^2=57.8$ ,  $df=22$ ,  $p<.001$ ). Review of the 22 equality constraints indicated the constraint on Item PC-3 (My backcountry camping practices in XNP are...) was noninvariant across groups ( $\chi^2=6.83$ ,  $p=.009$ ). Freeing this constraint the model was rerun. Results indicate the fit was acceptable ( $\chi^2=678.0$ ,  $S-B\chi^2=645.6$ ,  $df=427$ ,  $CFI=.936$ ,  $SRMR=.070$ ,  $RMSEA=.042$ ) and the improvement in model GOF was significant ( $\Delta S-$

$B\chi^2=8.20$ ,  $df=1$ ,  $p=.004$ ). Thus, we conclude the factor structure and data depict complete configural invariance and nearly complete metric invariance.

#### *Structural Regression Model*

Figure 4.2 presents the structural model tested in this study. The letter 'B' indicates paths (parameters) estimated between primary study constructs (latent factors), 'L' indicates coefficients between observed variables (items and/or questions) and latent factors, 'e' represents the error term of each observed variable, and 'D' indicates disturbance terms of the endogenous variables. All indicators were specified as reflective of their corresponding factors (Jarvis, et al., 2003).



*Figure 4.3* Structural model of the Theory of Planned Behavior. Includes ONP cross-loading & GNP error-covariance, direct effects, potential direct effects (dashed arrows), and parameters to be estimated.

### *Model Estimation*

Structural equation models were estimated following the configuration presented in Figure 4.2. Goodness-of-fit for both samples was within admissible bounds (Model 1a, Table 4.5). Prior to estimation of parameters, the plausibility of the second-order attitude construct was examined ('AT F2' in Figure 4.2). A previous investigation using confirmatory factor analysis to develop a multidimensional model of LNT attitudes elucidated that attitudes can be accounted for by a second-order factor; a factor was

termed ‘LNT Ethic’ by the researchers (Vagias, et al., in-development). However, to this point, the plausibility of an ‘Ethic’s Factor’ had not yet been tested as part of a predictive model.

Table 4.5  
*Summary of Goodness-of-Fit Statistics for Structural Regression Models*

SEM Model	Unit	Goodness-of-Fit Statistics						
		$\chi^2$	S-B $\chi^2$	df	p	CFI	SRMR	RMSEA (90% CI)
1a	ONP <sup>a</sup>	335.5	321.0	213	.000	.942	.061	.041 (.031-.050)
	GNP <sup>b</sup>	309.3	296.8	213	.000	.946	.058	.038 (.027-.048)
1b	ONP <sup>a</sup>	334.5	315.2	210	.000	.944	.061	.041 (.031, .049)
	GNP <sup>b</sup>	304.8	283.9	210	.000	.952	.056	.036 (.024, .046)

<sup>a</sup> cross-loading modeled between F2a & observed variable A-8

<sup>b</sup> error covariance modeled between observed variables A-4 & A-8

The test was conducted by modeling the data to the configuration in Figure 4.2 and including the dashed paths from the first order attitudinal factors to the outcome variable behavioral intentions (Model 1b, Table 4.5). A significant test result (statistically significant improvement in model fit) would indicate that individual attitudes operate independent the higher-order factor. Such evidence would suggest behavioral intentions are driven by specific LNT attitudes. Nonsignificant test results (no improvement in omnibus model fit) would lend support to the higher-order factor. In the context of the present research, such evidence would indicate that individual LNT attitudes can be accounted for by the LNT Ethic factor proposed by Vagias, et. al., (in-development) and would suggest the presence of an overall camping ethic. Test results

were nonsignificant for both groups ( $p > .05$ ). This finding indicates that individual LNT attitudes operate via or through of the ‘LNT Ethic’ factor is potentially empirical support for the presence of an ethic amongst both samples of backcountry visitors.

Table 4.6 provides summary of robust parameter estimates and the overall proportion of explained variance for the two models tested. For the ONP sample, with all paths estimated, the only significant predictor of BI was PBC-Perceived Difficulty (Beta=.452). This model explained 28% of the variance in the dependent variable. For the GNP with all paths estimated, three predictors were significant; Subjective Norms (B=.084), PBC-Perceived Difficulty (Beta=.287), and Self-reported knowledge of LNT practices (B=.242). This model explained 44.3% of the variance in the dependent variable BI.

Table 4.6

*Parameter Estimates (Robust) and Proportion of Variance Explained for Structural Regression Models*

ID	Variables	Path	Olympic National Park			Glacier National Park		
			Beta	S.E.	$\beta$	Beta	S.E.	$\beta$
AT F2	LNT Ethic	B <sub>1</sub>	-.002	.077	.113	.074	.050	.149
SN F3	Subjective Norms	B <sub>2</sub>	-.018	.089	-.003	** .084	.036	.196
PC F4	PBC; Perceived Control	B <sub>3</sub>	.077	.138	-.023	.054	.136	.030
PD F5	PBC; Perceived Difficulty	B <sub>4</sub>	*** .452	.113	.045	* .287	.135	.276
Know	Self-Reported Knowledge of LNT	B <sub>5</sub>	.099	.062	.472	*** .242	.048	.359
Proportion of Variance Explained: R <sup>2</sup>			28.0%			44.3%		

\*  $p \leq .05$ , \*\*  $p \leq .01$ , \*\*\*  $p \leq .001$

Beta = unstandardized coefficient, S.E. = standard error (robust estimate),  $\beta$  = standardized coefficient



## Discussion

The purpose of this study was to examine the viability of the TPB for predicting intentions to comply with recommended LNT principles in two NPS Units. This process involved developing a configural measurement model, cross-validating the model with a separate independent sample, examining measurement invariance across samples, and estimating structural regression models using a combination of latent factors and observed variables.

The ability to successfully model the GNP data to the configural measurement model developed with the ONP data provides evidence to the overall validity of the measures used. Indeed, cross-validation with a separate independent sample is one of the strongest tests of construct validity and speaks to the soundness of the measurement model. Discriminate validity was demonstrated through the relatively low latent variable correlations depicted in Table 4.4. This was true with the majority of the correlations except those sub-constructs that comprised the attitudinal construct (F2) of TPB. Here, as expected, latent variable correlations were quite high reflecting congruency between the various backcountry behavioral constructs. Several study constructs demonstrated less than desirable internal reliability, even for exploratory measures ( $\alpha < .60$ ) (Hatcher, 1994). However, this finding was not unexpected given the limited number of observed variables (items) per factor.

A number of salient findings from the research are worthy of further discussion. Both data provided excellent fit to the hypothesized measurement model; however, when entered in the SEM, beta coefficients indicated different constructs influence intentions to

comply with LNT practices depending on the NPS Unit. For park staff at ONP, targeting how prospective backcountry campers perceive the *difficulty* in carrying out recommended LNT practices is likely to be most influential in changing their behavioral intention to comply with recommended LNT practices. Conversely, at GNP the results suggest that a combination of targeting perceived difficulty, knowledge of the principles, and subjective norms would be most beneficial to addressing behavioral intentions with recommended LNT practices. This finding is consistent with Hammitt and Cole's (1998) postulation that 'knowledge of minimum-impact (LNT) techniques... are key components in managing backcountry recreation impacts and have been quite successful in reducing certain impacts' (pg. 186).

Of equal importance are the non-significant predictors. For the ONP sample, our data suggests that educational messages targeting attitudes toward the behavioral outcome, subjective norms, levels of perceived behavior control, and knowledge will be less influential on behavioral intentions to follow recommended LNT practices than addressing the difficulty visitors perceive in carrying out LNT practices. For the GNP sample, our data suggests that communication targeting salient attitudes toward LNT behaviors and levels of control will be less effective for changing backcountry recreationists' intentions to follow promoted LNT practices, than focusing education and communication on perceived difficulty, knowledge, and subjective norms regarding LNT behaviors.

Those charged with education dissemination at ONP are encouraged to consider the cross-loading between observed variable A-8 (having a campfire) and Factor 2a

(General Backcountry Behaviors). This finding suggests that campfires are *part of the backcountry experience* and that if this behavior is something management wishes to change, the behavioral change strategy should be embedded within a larger discussion about general backcountry behaviors. Conversely, with the GNP sample modeling the error-covariance between observed variables A-4 (camping with large groups (8 or more people) in the backcountry) and A-8 (having a campfire) proved a significant improvement to the model. This finding indicates that, for larger groups, campfires are part of the experience. For managers, if fires are an issue and is a behavior they wish to curb, targeting the belief structures of this individuals traveling in large groups is likely to be most effective.

As within all research, limitations must be recognized. One concern is the cross-sectional study design. The data were collected primarily from one location at each park during annual peak use. Future researchers are advised to select representative samples that cover the entire ‘season’ of backcountry use in the study areas. A second limitation is the use of self-reported measures. There is also the possibility that responses are tainted by social desirability bias. Thus, if logistically feasible, corroborating our findings with actual ‘on the ground’ measures would be the next logical step. Finally, the TPB is causal in direction yet our analysis, like many TPB based studies, is correlational (Armitage & Conner, 2001; Sutton, 1998), thus future researchers are encouraged to obtain other types of data such as direct observations of visitor behavior.

## Conclusions & Future Research Directions

This study begins to fill what previously has been a large void in the recreation ecology and backcountry management literature – assessing the efficacy and analyzing determinants of widely promoted LNT guidelines. The overall proportion of variance explained by our final models ranging from 27.4% (ONP) to 44.9% (GNP) and shows our extended version of the TPB to be robust in predicting compliance with recommended LNT practices. However, even our best model leaves more than half of the variance still *unaccounted* for, despite our use of SEM procedures to control for measurement error. Thus, future researchers are advised to address other measurement issues, particularly with refinement of indicator variables as well as the inclusion of other predictor variables. For instance, the items used to reflect the PBC-PC (F4) and Behavioral Intentions (F1) Constructs were general and lacked a high level of specificity. Additional items, developed to cover both the breadth and detail of the LNT principles (Figure 4.1), may prove to be more predictive of overall intentions to comply with recommended practices. Other predictor variables may also prove beneficial to our understanding of compliance with LNT principles. Place attachment and past behavior are two such variables which future researchers are encouraged to examine when examining determinants of human behavior regarding minimum-impact practices.

## CHAPTER 5

### MANUSCRIPT #3: DIFFUSION OF THE LEAVE NO TRACE VISITOR

#### EDUCATION PROGRAM IN TWO U.S. NATIONAL PARKS

Intended outlet

Journal of Leisure Research (abstract <120 words, body ~20-30 pages)

Abstract

The purpose of this article is to discuss the diffusion and perceived effectiveness of the Leave No Trace (LNT) Visitor Education Program in two keystone U.S. National Park Service (NPS) Units. LNT is the most pervasive environmental ethics communication initiative in existence and is designed to encourage human powered recreationists in backcountry settings to minimize their impacts upon the landscape. This article explores the potential for a general theory of communication, Diffusion of Innovations Theory (Rogers, 2003), to offer insight into improving educational effectiveness in natural resource management contexts. Data were collected during the summer of 2007 from overnight backcountry recreationists in Glacier National Park, MT, and Olympic National Park, WA following a modified Dillman procedure. Results indicate the vast majority of respondents were aware and highly supportive of the LNT program, and highlight the role of both family-friends as well as the NPS for diffusing the LNT message amongst recreationists. T-test analyses indicate marginal effectiveness of four primary dissemination strategies on self-reported knowledge of principles; however, effectiveness

varies widely by unit. Significant and negative beta coefficients exist between perceived skill level regarding backcountry travel and perceptions of information gleaned from various LNT dissemination strategies, potentially indicating the presence of an ‘expert’ like mentality amongst populations sampled. For the practitioner, management implications and suggestions for more effectively disseminating the LNT message amongst the recreating public are offered.

#### Keywords

leave no trace, diffusion theory, persuasive education, protected area visitor education

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## Introduction & Purpose

In the realm of protected area management, influencing visitor behavior to assist with meeting management objectives can be a particularly complicated challenge to overcome. To facilitate meeting these challenges, managers frequently utilize educational based strategies designed to increase knowledge, raise awareness (Ballantyne & Uzzell, 1999), modify attitudes, promote conservation/stewardship behaviors (Kohl, 2005), mitigate negative behaviors (Kernan & Drogin, 1995; Kimmel, 1999), enhance visitor experiences and satisfaction, and/or raise support for larger conservation efforts (Ham & Krumpe, 1996). In fact, education is regarded as the most appropriate visitor management strategy in wilderness and other protected area settings and is preferred over enforcement or sanctions on both philosophical and practical grounds (Hendee & Dawson, 2002; Passineau, Roggenbuck, & Stubbs, 1994).

The most widely utilized visitor education message employed in backcountry settings is Leave No Trace (LNT), a series of seven principles or ‘best practices’ designed to encourage human powered recreationists in backcountry settings to minimize impacts upon the ecological and sociological landscape (Harmon, 1997). The program was formally adopted by the four primary federal land management agencies (US Forest Service, Bureau of Land Management, Fish and Wildlife Service, and National Park

Service) in 1993 via a memorandum of understanding ([www.lnt.org](http://www.lnt.org)), however empirical evaluations regarding both the efficacy and diffusion of the program have been scant within the literature (Daniels & Marion, 2005; Marion & Reid, 2001). Even more generally, it has been posited that there is a lack of research exploring the effectiveness of education and interpretation efforts for influencing visitors in natural areas (Beckmann, 1998; Orams, 1995). For researchers, salient questions may include assessing who the message is reaching, how various messages are perceived, what communication channels are perceived as most effective, and what factors inhibit widespread diffusion of the messages. With these global questions in mind, the purpose of this article is to provide initial inroads into exploring levels of diffusion and perceived efficacy of the LNT program amongst backcountry travelers in two National Park Service (NPS) Units. The following six questions, grounded in part within Rogers Diffusion of Innovations Theory (2003), drove our current investigation:

1. What proportion of respondents are aware of LNT?
2. Amongst those who have heard of LNT, who/what first made them aware of LNT and who/what are their primary sources of information regarding LNT?
3. Do global attitudes regarding the efficacy of the LNT Program and self-reported knowledge of LNT principles differ between NPS Units investigated and what is the relationship between these two variables?
4. What proportion of respondents do four key LNT education dissemination strategies reach and how effective are these strategies? Do perceptions of effectiveness differ between units?



5. Within NPS Units, do levels of self-reported knowledge of LNT principles differ between those exposed to a dissemination strategy and those who were not?
6. What effect do perceptions of backcountry skill level (skill) and self-reported knowledge of LNT principles (knowledge) have on respondents' perceived learning from the four dissemination strategies?

## Literature Review

### *Visitor Management Strategies in Natural Areas*

For protected area managers, behaviors that are perceived to have little or no impact on the environment are usually of little concern. Conversely, behaviors that negatively affect the environment are of significant concern and can either be ecological, social, or both (Ham & Krumpe, 1996). Empirical investigations have illustrated how nominal recreational use can accentuate resource degradation (Leung & Marion, 2000) and cumulative impacts can be substantial (Hammit & Cole, 1998). To assist with meeting management objectives, land managers employ either direct (hard or regulatory) strategies and/or indirect (soft or nonregulatory) strategies (Hendee, et al., 1990). Direct visitor management strategies may include the use of regulations, sanctions, or physical management such as barriers, boardwalks or fencing (Duncan & Martin, 2002; Kuo, 2002). Indirect visitor management primarily focuses on visitor education and/or interpretation efforts (Duncan & Martin, 2002). The use of education is considered 'light handed' in that research has shown education is favored by visitors (Hendee & Dawson, 2002; McCool & Christensen, 1996), can frequently serve to enhance the visitors'

experience through education and information (Hendee & Dawson, 2002; Roggenbuck, 1992), and is preferred by managers over direct strategies as it is less obtrusive to the experience (Douchette & Cole, 1993).

Cole, Peterson, & Lucas (1987) indicate many visitor induced problems are a result of inappropriate behavior. To further understand and classify the issues and problems associated with humans visiting parks and protected areas and the ability of educational interventions to address such problem behaviors, a typology has been presented that includes five classifications of problem behaviors: illegal actions, unavoidable actions, careless actions, unskilled actions, and uninformed actions (Hendee, et al., 1990; Manning, 2003; Roggenbuck, 1992). Manning (2003) has suggested that while education will have limited effectiveness to curb negative behaviors brought about by unavoidable and illegal behaviors, it can be an effective means for addressing careless, unskilled, and/or uninformed actions. Examples of such behaviors in backcountry environments may include inappropriate human/wildlife interactions, disrespect towards other visitors, off-trail hiking, and improper camping practices, among many others.

#### *Leave No Trace*

Various minimum-impact visitor education programs and strategies have been developed over the past 30 years to help curtail the impact of recreationists on wildlands, including LNT, Codes of Conduct, and Guidelines for Tourists (Marion & Reid, 2007). One of the earliest programs was initiated in the 1960s when the US Forest Service (USFS) began to encourage 'pack it in – pack it out' messages to the public (Monz, 1994). This fledgling effort was based in part on the success of the anti-forest fire

campaign (ex: Smoky Bear) and was aimed to reduce littering in backcountry. These early messages evolved to what are now considered precursors to LNT (Daniels & Marion, 2005). By the 1980s, it was becoming evident that a more comprehensive program was needed to address impacts from recreationists upon the nation's backcountry. To help meet the need of educating the recreating public, the USFS teamed with the National Outdoor Leadership School (NOLS) in the early 1990s to develop the LNT message (Marion & Reid, 2001). The LNT message is built upon the research of various recreation ecologists and informed the development of a broad conceptual framework made up of seven principles which are suitable for application in a multitude of environmental settings (Monz, 1994). The seven LNT principles are: (1) Plan ahead and prepare, (2) Travel and camp on durable surfaces, (3) Dispose of waste properly, (4) Leave what you find, (5) Minimize campfire impacts, (6) Respect wildlife, and (7) Be considerate of other visitors.

### *Education Dissemination Strategies*

To disseminate education messages such as LNT, managers frequently employ one or more techniques. In a study of wilderness managers, Douchette & Cole (1993) provided a review of the primary techniques used to disseminate education, classifying these strategies into two categories; media-based and personnel-based educational techniques. Media-based educational techniques include brochures, maps, posters, signs, guidebooks, kiosks, displays, videos, slide shows, radio, computers, and television. Personnel-based educational techniques include interpretation, presentations, trainings, inter-personal communication, etc., in agency offices, visitor centers, at trailheads,

campgrounds, in public meetings, and in the backcountry. In a study conducted with US National Park Service managers, Marion, Roggenbuck, and Manning (1993) discovered three out of four National Parks had a minimum-impact educational strategy in place, however only 51% of those parks provided literature to most or all backcountry visitors. In short, there appears to be wide variability in educational dissemination strategies employed by federal land managers to promote minimum-impact education.

Investigations assessing the role of education in protected area contexts are primarily interested in the efficacy of education to influence knowledge, attitudes, and/or behaviors. Marion and Reid (2007) and Manning (2003) both provide summaries of prior studies and review the theories that have underpinned these investigations. It deserves note that a substantial portion of past evaluations have been atheoretical. Manning (2003) has classified these investigations into four categories, the influence of education on: visitor use patterns, knowledge (particular focus on minimizing impacts), visitor attitudes concerning management policies, and depreciative behavior. We have taken a different approach by classifying past efforts to assess educational efficacy into the following four categories; (1) printed media/literature (brochures, signs, kiosks, etc), (2) face-to-face communication with park personnel, (3) audio/visual presentations, and (4) websites.

#### *Printed Media/Literature*

A substantial amount of literature exists examining the influence of printed media/literature on visitors' knowledge, attitudes, and behaviors. In one of the earliest investigations, Lime and Lucas (1977) examined the influence of mailed information on

the selection of travel destinations in the boundary waters canoe area. The conclusion was that mailed information, if provided early enough, can assist visitors with trip planning. A second early study examined how trailhead brochures might be used to disperse wilderness campers in a heavily used wilderness area in the southeastern US (Roggenbuck & Berrier, 1982). Results were nonsignificant between the treatment and control group for dispersing visitors. Consistent with the Roggenbuck & Berrier (1982) study, Passineau, Roggenbuck, and Stubbs (1994) discovered that trailhead posters did not cause significant changes regarding wilderness visitors' behavioral intentions and adoption of minimum-impact practices. In a study of trailside bulletin boards, Cole, Hammond, and McCool (1997) found significant increases in knowledge among hikers exposed to a message board. However, the amount of material on the board appeared to be a limiting factor with the researchers concluding that those exposed to more than two messages could not remember any more than those exposed to only two could. Additionally, various types of user groups would pay longer attention to message boards; 71% of hikers stopped to review messages while less than one in three equestrians stopped. A more recent study using an experimental design assessed differences in interpretive (educational) and sanction messages on behavioral intentions. Across all four scenarios, interpretive messages were as effective as sanction based messages, and in one case more effective. In all scenarios, messages were more effective than no message at influencing behavior (Duncan & Martin, 2002). In summary, the effects of printed media seem to be minimal on impacting the knowledge and/or behavior and behavioral intentions of those exposed to them. Additionally, there would appear to be a limiting

factor related to sheer amount of information, which supports other interpretation and education research and theories such as Schema Theory which suggests people cannot remember more than 3-5 themes (Ham, 1992).

#### *Face-to-Face Communication with Park Personnel*

In a study of wilderness managers, face-to-face communication with agency personnel was perceived to be the most effective educational strategy (Douchette & Cole, 1993). Evaluations of visitors in natural areas seem to confirm this finding. A study of hikers at Mt. Rainier National Park found those hikers given an informative talk by rangers were much less likely to engage in off-trail hiking than those in the control group (Kernan & Drogin, 1995). This echoes the findings of Vander Stoep & Roggenbuck (1996) who indicated personnel contact to be the most effective educational strategy for influencing visitors' behaviors in directions preferred by management.

#### *Audio-Visual Presentations*

Assessment of the effectiveness of audio-visual presentations for influencing knowledge, attitudes, and behavior in natural area contexts is limited. As part of a larger study, Dowell & McCool (1986) assessed the effectiveness of a slide show on knowledge using a sample of boy scouts. With advances in technology, audio/visual educational dissemination strategies will likely see increased use however, a review of the literature failed to illuminate relevant investigations regarding the effectiveness of audio-visual presentations in natural area contexts.

#### *Websites*

The internet is the newest dissemination tool being utilized by wilderness and other natural area managers as a strategy for influencing knowledge, attitudes, and behaviors of visitors and is a relatively unexplored avenue for research. While not addressing effectiveness, Griffin (2004) explored web-based dissemination of LNT information in 45 NPS units containing wilderness via NPS websites. This study concluded that approximately two thirds of NPS websites mention LNT although less than 30% linked to the LNT webpage. Despite the lack of evidence, dissemination of messages via the internet is likely to become more prevalent in the future.

There are several conclusions that can be garnered from the literature review above. First, as Manning (2003) and Marion and Reid (2007) suggest, visitor education appears effective in influencing knowledge, attitudes, and behavior of visitors to protected areas and supports the utilization of education as a management strategy. However, it appears that educational effectiveness varies by strategy and content. Manning (2003) recommends the use of ‘multiple media’ to disseminate information (p. 25) although research has shown there to be a ‘threshold,’ where information overload, either from a single source, or multiple sources such as signs, personnel, and audio-visual, can lead to a negative experience (Cole, et al., 1997; Roggenbuck, 1992). Thus, promotion of messages should focus on simple messages that are clear and concise (Cole, et al., 1997). Finally, emerging principles for education have been provided by Manning (2003), and include; reaching the visitor during trip planning, targeting underlying beliefs of visitors and the consequences of target behaviors, and when possible providing personal contact between agency personnel and the visitor.

## Theoretical Framework

How do innovations, those ideas, practices or objects that are new, become adopted into society? What causes one idea to rapidly become diffused while others do not? Innovations succeed or fail for any number of reasons; Diffusion of Innovations Theory (DT) seeks to explain why an idea becomes adopted into society by exploring the variables that help account for adoption (Rogers, 2003). By better understanding the factors that influence adoption of innovations, more efficient strategies for diffusing ideas can be developed. Within the natural resource management field, additional understanding of DT has been identified as a tool to lessen the lag-time between scientific research and implementation by management (Wright, 2004). For the present investigation, theoretical insight gleaned from DT can aid our investigation of visitors' awareness levels of the LNT Program and potentially offer guidance with developing strategies to more effectively disseminate the message.

Diffusion is defined as “the process in which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 2003, p. 5). Diffusion is not a single or unified theory; instead, the theory relies on insight from a variety of disciplines. Thus, the adoption of an innovation, while accounted for in the meta-lens of diffusion theory, can likely be accounted for by various underlying causes. Rogers (2003) posits there are five explanatory variables that, taken together, account for the rate of adoption; (1) perceived attributes of the innovation, (2) type of innovation-decision, (3) communication channels, (4) nature of the social system, and (5) the extent of change agents' promotion efforts. Perceived attributes refer to the



characteristics of the innovation as they are perceived by individuals considering their adoption. The type of innovation-decision refers to the level of autonomy individuals have toward adopting the innovation in question. Communication channels include mass media such as magazines or television advertising, interpersonal channels such as word-of-mouth, targeted educational initiatives including printed brochures, video presentations, discussions with personnel, and/or interpretation efforts. A social system “is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (Rogers, 2003, p. 37). Finally ‘change agents’ are professional individuals who “influence the innovation-decision in a direction deemed desirable by the change agency” (Rogers, 2003, p.27).

Diffusion occurs at the individual level, which is called the ‘innovation-decision’ process, and at the social system level, which refers to the rate of adoption within the social system. The innovation-decision process is described as the period of time that elapses from when an individual is first made aware of an innovation to when they accept or reject the innovation. During this stage Rogers posits there are five components of the process; *knowledge* – when an individual learns of an innovation, *persuasion* – when an individual forms a favorable/unfavorable attitude regarding the innovation, *decision* – individual undertakes actions that lead to adopting or rejecting the innovation, *implementation* – individual puts the innovation into practice, and *confirmation* – individual seeks reinforcement about innovation.

In the present investigation, we examine LNT awareness levels among wilderness visitors' to two NPS units and how effective they perceived the 'change agents' promotion of the LNT message to be.

## Methods

### *Study Locations*

This study sought to utilize insight from DT to investigate the diffusion and perceived efficacy of LNT education dissemination strategies in two NPS Units. The two study locations, Glacier National Park (GNP) Montana and Olympic National Park (ONP) Washington, were selected for the following criteria. Both parks contain large contiguous wilderness/de facto wilderness areas, are recognized backpacking destinations, require backcountry permits and pre-trip check-ins by visitors, use a range of education strategies, and provide different geographic locations and ecosystems. Glacier National Park encompasses approximately one million acres of forests, lakes, and mountain peaks. Annually, the park receives 25,000 backcountry overnight visitor stays, primarily concentrated in the months of July and August. There are five backcountry permit issuing stations within the park with the Apgar Backcountry Permit Center on the western gate receiving approximately 60-65% of the total backcountry volume. Olympic National Park is a geographic medley of rugged coastline, temperate rainforest, and high alpine peaks and meadows. Covering nearly one million acres, the park is 95% designated wilderness. In 2006, the National Park Service (NPS) Statistics Use Office recorded approximately 40,000 overnight backcountry visitor nights.

### *Sampling & Response Rate*

Study participants consisted of overnight backpackers intercepted at primary backcountry permit centers in GNP and ONP during the summer 2007. Contact information was obtained through a systematic sampling strategy at a time chosen to coincide with annual historical peak visitation. Primary study data were subsequently collected using a mail-back questionnaire following a modified Dillman procedure (2007). After removing undeliverable addresses, the adjusted response rate was 68% for GNP (n=279) and 73% for ONP (n=314). A phone interview (n=30/unit) was conducted of non-respondents to ascertain the presence of non-response bias. There were no significant differences between respondents and nonrespondents.

### *Operationalization of Study Variables*

The following variables were utilized to explore the diffusion and perceived effectiveness of the LNT Visitor Education Program in two keystone U.S. National Park Service (NPS) Units.

Respondents were asked to report three aspects related to their experience use history (Schreyer & Lime, 1984) with overnight backcountry camping; if they camped overnight in the backcountry of the park before being contacted for this study, the year they first overnight backcountry camped (any location), and average number of overnight backcountry trips per year (any location).

Backcountry skill levels were measured with the following multiple choice question: 'regarding the skills necessary for backcountry travel, I consider myself a.' Response categories were 1=novice, 2=beginner, 3=intermediate, 4=advanced, 5=expert.

Respondents were asked if they had ever heard of Leave No Trace. This question served as both a filter for the remaining questions related to LNT educational efficacy and as the initial investigation into the rate and extent of adoption of LNT into the study population. As a follow-up, those who answered ‘yes’ were asked to indicate the year they first learned of LNT.

Respondents were asked to indicate both their initial and primary sources of LNT information from eight predetermined response categories: family/friends, information kiosk/park literature, popular media (magazines, books), class/course, park personnel/park education talk, boy/girl scouts, LNT webpage, internet, and a space for ‘other.’

Exposure to and perceived effectiveness of four dissemination strategies were examined (face to face, video, printed literature, website). To assess how these dissemination strategies were reaching intended audience members and the effect these interventions have on global LNT attitudes, a two-part question was devised. All respondents were asked to indicate (yes or no) if they had been exposed to each of the four dissemination strategies. For those who answered ‘yes,’ a follow-up question requested that respondents indicate how much they perceived learning about LNT from the experience, using a 7-point scale ranging from ‘0’ (nothing) to ‘6’ (extensive amount).

To assess global attitudes regarding LNT, a composite measure was created from the three items in Table 5.1. Each of these three items were measured on a 7-point scale ranging from 1=strongly disagree, 4=neutral, to 7=strongly agree. A reliability analysis

and principal component analysis were conducted on each sample independently prior to creation of composite scores to ascertain the psychometric qualities of the latent factor, results of which are presented in Table 5.1.

Table 5.1  
*Reliability & Principle Component Analysis of LNT Global Attitudinal Items and Composite Measure*

Scale / Item	GNP				ONP			
	N	$\lambda^a$	M <sup>b</sup>	SD	N	$\lambda^a$	M <sup>b</sup>	SD
It is important to use minimum-impact/LNT techniques when in the backcountry.	265	.64	6.49	1.15	302	.83	6.50	1.10
If I learned my actions in the backcountry damaged the environment I would change my behavior.	265	.83	6.54	.79	302	.88	6.46	.88
I get upset when I see other individuals in the backcountry not following minimum-impact / LNT practices.	265	.77	6.17	1.01	302	.78	6.13	1.13
Overall composite mean score & SD			19.20	2.23			19.09	2.62
Eigenvalue	1.81				2.21			
Percentage of total variance	56.34				69.01			
Reliability (Cronbach's alpha)	.61				.77			

<sup>a</sup> Principal Component Analysis

<sup>b</sup> Based on a 7 point scale; 1=strongly disagree, 4=neutral, 7=strongly agree. Higher score reflects stronger attitude regarding LNT efficacy

Self-reported knowledge level regarding LNT was measured via the statement ‘how would you describe your current knowledge of Leave No Trace practices?’ Response categories were 0=no knowledge, 1=very limited, 2=limited, 3=average, 4=above average, 5=extensive and 6=expert.

#### *Preliminary Data Checks*

To guard against data contamination/coding errors, both univariate and multivariate checks were completed separately for both samples following procedures recommended by Tabachnick & Fidell (2001) and Cohen, Cohen, West, and Aiken (2003). Univariate outliers were examined by exploring ranges, means, and dispersion of scores. Multivariate outliers were explored via regression-based techniques and graphical methods including analysis of Studentized Deleted Residuals, Mahalanobis Distance, and Cooks D values (Fox, 1991; Tabachnick & Fidell, 2001). Two cases from the ONP sample data and one from GNP were identified as exceeding cutoff criteria for multivariate outliers and were deleted from subsequent analysis (Fox, 1991). Elimination of these cases represented less than one percent of the total data available for subsequent analysis. Cases missing greater than 50% of data across study variables were deleted, resulting in the elimination of one case from GNP and three cases from ONP. At the conclusion of these preliminary data screening procedures there were 277 valid cases from GNP and 309 valid cases from ONP.

## Results

### *Change Agents' Promotion Efforts: LNT Dissemination Strategies in the two Study Areas*

Promotion of the LNT message in GNP is inextricably linked to educating visitors regarding grizzly bear camping procedures and proper trip preparation into the high alpine environment of the park. The park has a document, the "Backcountry Guide," available to download from the park webpage that details the permit process, recommended backcountry practices in bear country, hazards, campground information,

route planning, amongst other pertinent details. All trip leaders are required to watch a 14-minute video regarding backcountry camping practices (this dissemination tool is also available for viewing online). The video content does not focus exclusively on LNT, but rather focuses on camping in bear country and the practices necessary to make the experience as safe and enjoyable as possible. After viewing the video and just before receiving the permit, a ranger addresses the entire group to answer any questions and review the rules and regulations (many oriented around LNT practices) regarding backcountry camping. Based on the researchers' observation, the average party spends approximately 30 minutes in the Apgar BC Permit Center planning, permitting, viewing videos, and reviewing information and regulations. Finally, on the backcountry permit, each backcountry party receives a 'backcountry camping checklist' that lists all recommended and mandatory backcountry practices, many of which are based on the LNT principles.

ONP backcountry visitors are required to pick up wilderness camping permits in person from one of the ONP backcountry or visitor centers. The majority of ONP backcountry visitors stop at the Wilderness Information Center (WIC) in Port Angeles, Washington. Upon entry into the WIC, NPS rangers review trip itineraries with backcountry visitors and provide basic recommendations. Park staff do not provide extensive assistance to visitors in trip planning, route finding and minimum-impact practices. This is likely due to the sheer volume of backcountry enthusiasts obtaining permits at the WIC. It bears note that the WIC has approximately the same size staff as Apgar Backcountry Permit Center at GNP (approximately 8-10) but processes nearly

twice the annual volume of backcountry visitors (25,000 verses 40,000, 2006 NPS Statistics Use Office). Olympic National Park has developed an extensive website for promoting the LNT message and a recent paper by Griffin (2004) noted that the park references LNT extensively on all backcountry website pages. Olympic National Park also produces the “Wilderness Trip Planner,” a detailed informational brochure/map that details introductory information, backcountry destinations, the permit processes, the LNT principles, and a full map of the park.

#### *Demographic Characteristics & Experience Use History of Respondents*

Over 60% of both samples were male. ONP respondents were, on average, 41.5 years of age while GNP respondents were, on average, 36.2 year of age. Greater than 92% in both samples identified s White (not of Hispanic descent). Twenty-one percent of GNP respondents and 33% of ONP respondents indicated a household income of greater than 100k. Respondents were highly educated; 91% of GNP respondents and 96% of ONP respondents reported having earned a college degree or higher.

Experience Use History (EUH) refers to ones prior experience in relation to the activity under investigation (Schreyer & Lime, 1984; Schreyer, Lime, & Williams, 1984). Three out of every four GNP respondents (75%) indicated that this was their first overnight backcountry trip in the park. Conversely, two out of three (66%) ONP respondents indicated prior camping experience in the park. Consistent with the discrepancy in mean ages, ONP respondents reported longer involvement in backcountry camping than their GNP counterparts; 21.6 years verses 13.4 years, respectively. In an



average year, both groups indicated that they camp approximately three separate times (ONP = 2.7 days and GNP = 2.9 days).

*Research Question #1: At an overall awareness level, how diffuse is Leave No Trace?*

Respondents were asked if they had ever heard of Leave No Trace. Just under 94% (n=257) of GNP respondents and 97.7% (n=302) of ONP respondents indicated having heard of LNT prior to their participation in this study. If a respondent answered 'yes,' they were asked to indicate the year that they first heard of LNT. Olympic NP respondents first heard of LNT, on average, in 1992. Consistent with the variation in the duration of backcountry camping involvement, GNP respondents indicated first hearing of LNT, on average, in 1995. The mean difference between samples of 3.19 years was significant ( $t=3.20$ ,  $p<.01$ ). Further, length of awareness of LNT is significantly and positively correlated with years of overnight backcountry experience in both units (GNP  $r=.693$ ,  $p<.001$ ; ONP  $r=.589$ ,  $p<.001$ ). However, length of awareness of LNT is not correlated with the frequency respondents annually engaged in overnight backcountry experiences (GNP:  $r=.081$ ,  $p=.235$ ; ONP:  $r=.000$ ,  $p=.999$ ).

*Research Question #2: Amongst those who have heard of LNT, who/what first made them aware of LNT and who/what are their primary sources of information regarding LNT?*

Respondents were asked to indicate where or from whom they first heard about LNT. Nearly 30% of respondents from both units indicated family/friends as their initial source of LNT information (Table 5.2). The combination of two park outreach strategies, information kiosks/park literature and park personnel, were the initial source of LNT information for 27% of GNP and ONP respondents. For 23% of GNP respondents, park

personnel/park education talks were the most frequently reported ‘primary source’ of LNT information. For 26.5% of ONP respondents, family and friends were the most frequently reported ‘primary source’ of LNT information. Of interest to park managers and others charged with dissemination of LNT, park outreach strategies such as information kiosks/park literature and contact personnel were indicated by 41.7% of GNP visitors and 34.6% of ONP visitors as their primary source of LNT information.

Table 5.2  
*Initial & Primary Sources of LNT Information*

Source	Initial Source of LNT Information				Primary Source of LNT Information			
	GNP		ONP		GNP		ONP	
	N	%	N	%	N	%	N	%
Family / Friends	75	29.3	83	28.3	47	18.7	78	26.5
Information kiosk / Park literature	34	13.3	61	20.8	47	18.7	71	24.1
Park personnel / Park education talk	35	13.7	17	5.8	58	23.0	31	10.5
Popular media (books, magazines)	34	13.3	32	10.9	33	13.1	25	8.5
Boy / Girl Scouts	24	9.4	37	12.6	16	6.3	25	8.5
Class / Course	19	7.4	25	8.5	15	6.0	17	5.8
Internet in general	3	1.2	4	1.4	10	4.0	16	5.4
LNT Webpage	1	0.4	2	0.7	5	2.0	3	1.0
Other	31	12.1	32	10.9	21	8.3	28	9.5

Review of the ‘other’ category for LNT sources (both initial and primary) revealed wide ranging responses. Many individuals who answered ‘other’ for initial source of LNT wrote in responses such as television, summer camps, university wilderness orientation programs, state and federal summer employment such as backcountry firefighting, nongovernmental organizations such as the Sierra Club,

Audubon, as well as others. Regarding primary sources of LNT information, respondents who answered ‘other’ wrote in books, maps and literature from land management agencies, NGO’s such as the National Outdoor Leadership School, Outward Bound, and Earth Corps, as well as the resources reported under ‘initial sources.’

*Research Question #3: Do global attitudes regarding the efficacy of the LNT Program and self-reported knowledge of LNT principles differ between NPS Units investigated and what is the relationship between these two variables?*

The overall composite mean scores reported in Table 5.1 were utilized to examine if differences exist between units regarding the global LNT attitudes. Respondents in both units had equally positive global attitudes toward the efficacy of the LNT program ( $M=6.40$  for GNP and  $M=6.37$  for ONP;  $t=.442$ ,  $p=.659$ ). To evaluate if self-reported knowledge of LNT principles differ between units, mean scores for the single item were compared. GNP respondents, on average, rated their knowledge of LNT principles higher than their ONP counterparts did (GNP;  $M=4.20$ ,  $SD=.82$ , & ONP;  $M=3.97$ ,  $SD=.89$ ). A t-test indicated significant differences between units ( $t=3.34$ ,  $p=.001$ ). To determine the relationship between self-reported knowledge of LNT principle

s and the global composite attitudinal measure, a simple correlation analysis was conducted. Correlations were significant in both groups (GNP,  $r=.180$ ,  $p=.004$ ; ONP,  $r=.316$ ,  $p<.001$ ). Examination of scatterplots did not support the presence of curvilinearity in the data suggesting that as self-reported knowledge of LNT principles increases global attitudes regarding the efficacy of the program similarly increase.

*Research Question #4: What proportion of respondents do the four key LNT education dissemination strategies reach? How effective are the strategies perceived to be, and do perceptions of effectiveness differ between units?*

The two NPS Units under investigation utilized up to four communication outreach strategies to promote the LNT message: face-to-face communication from park staff/volunteer to visitors, video presentations, printed park literature, and the unit's web page. Note ONP does not utilize a video to disseminate LNT or other backcountry camping information. The most utilized dissemination strategy was the 14-minute video at GNP, which was viewed by over 86% of the sample (Table 5.3). Seventy-seven percent of GNP and 53% of ONP respondents indicated that the ranger staff discussed LNT principles with them. Despite the high level of use of the internet in daily life, only 41.5% of GNP and 20.3% of ONP respondents reported using the internet to learn more about LNT. However, the ONP respondents that reported visiting the park webpage perceived it as the most effective dissemination strategy ( $m=3.33$ ,  $SD=1.43$ ). Amongst GNP respondents, the video was reported as the most effective dissemination strategy ( $m=3.86$ ,  $SD=1.73$ ) on the single item scale where 0=nothing and 6= an extensive amount. T-test analyses were utilized to examine differences between groups regarding perceived effectiveness of three of the dissemination strategies. Results suggest significant differences exist between units on two of the three dissemination strategies investigated; GNP respondents perceived learning more about LNT from speaking with a ranger ( $p=.003$ ) and printed park literature ( $p<.001$ ) than their ONP counterparts.

Nonsignificant differences existed between units on perceived amount learned from visiting the respective park webpage's ( $p=.212$ ).

Table 5.3

*Proportion of Respondents Reached, Perceived Effectiveness, and Between Group Differences Regarding the Four Primary Education Dissemination Strategies*

Did you do any of the following before your recent trip?	Unit		N	Percent	Perceived effectiveness <sup>a</sup>		t-test: between group differences	
					M <sup>b</sup>	SD	t	p-value
Speak with a ranger regarding minimum-impact / LNT practices?	GNP	No	63	23.0	--	--	3.00	.003
		Yes	211	77.0	3.31	1.45		
	ONP	No	145	47.5	--	--		
		Yes	160	52.5	2.86	1.40		
Watch a video regarding minimum-impact / LNT practices?	GNP	No	38	13.9	--	--	--	--
		Yes	236	86.1	3.86	1.71		
	ONP	No	305	100.0	--	--		
		Yes	--	--	--	--		
Review any printed park literature regarding minimum-impact / LNT practices?	GNP	No	77	28.1	--	--	4.23	.000
		Yes	197	71.9	3.59	1.55		
	ONP	No	139	45.6	--	--		
		Yes	166	54.4	2.94	1.38		
Visit the XNP website to learn about minimum-impact / LNT practices?	GNP	No	159	58.5	--	--	.833	.212
		Yes	113	41.5	3.54	1.87		
	ONP	No	243	79.7	--	--		
		Yes	62	20.3	3.33	1.43		

<sup>a</sup> only those who answered 'yes' indicated perceived levels of effectiveness for the dissemination strategy

<sup>b</sup> 0=nothing to 6=extensive amount

*Research Question #5: Within NPS Units, do levels of self-reported knowledge of LNT principles differ between those exposed to a dissemination strategy and those who were not?*

Independent sample *t*-test analyses were used to examine if significant differences in knowledge of LNT principles existed within NPS Units between those respondents exposed to a dissemination strategy and those who were not (Table 5.4). Significantly ( $p < .05$ ) higher levels of self reported knowledge were found with GNP respondents exposed to both ‘speaking with a ranger regarding LNT’ and ‘visiting the GNP website to learn more about LNT practices.’ None of the *t*-test analyses indicated significant differences for the ONP sample ( $p > .05$ ). Of note however is the fact that all of the mean scores are higher for those exposed to a dissemination strategy verse those who were not in every instance.

Table 5.4

*T-test Analyses of Within Group Differences Between Individuals Exposed/not Exposed to a Dissemination Strategy on Self-Reported LNT Knowledge*

	Unit		N	M <sup>a</sup>	SD	<i>t</i>	p-value
Speak with a ranger regarding minimum-impact / LNT practices?	GNP	No	61	3.98	1.04	2.23	.027
		Yes	206	4.26	.78		
	ONP	No	140	3.87	1.04	1.64	.103
		Yes	159	4.05	.83		
Watch a video regarding minimum-impact / LNT practices?	GNP	No	37	4.05	1.03	1.10	.274
		Yes	230	4.22	.84		
	ONP	No	--	--	--	--	--
		Yes	--	--	--		
Review any printed park literature regarding minimum-impact / LNT practices?	GNP	No	75	4.05	1.05	1.51	.134
		Yes	192	4.26	.77		
	ONP	No	137	3.85	1.10	1.87	.063
		Yes	162	4.06	.76		
Visit the XNP website to learn about minimum-impact / LNT practices?	GNP	No	155	4.10	.92	2.24	.026
		Yes	110	4.34	.76		
	ONP	No	241	3.95	.96	.77	.440
		Yes	58	4.05	.83		

<sup>a</sup> Mean scores regarding self-reported knowledge of LNT principles

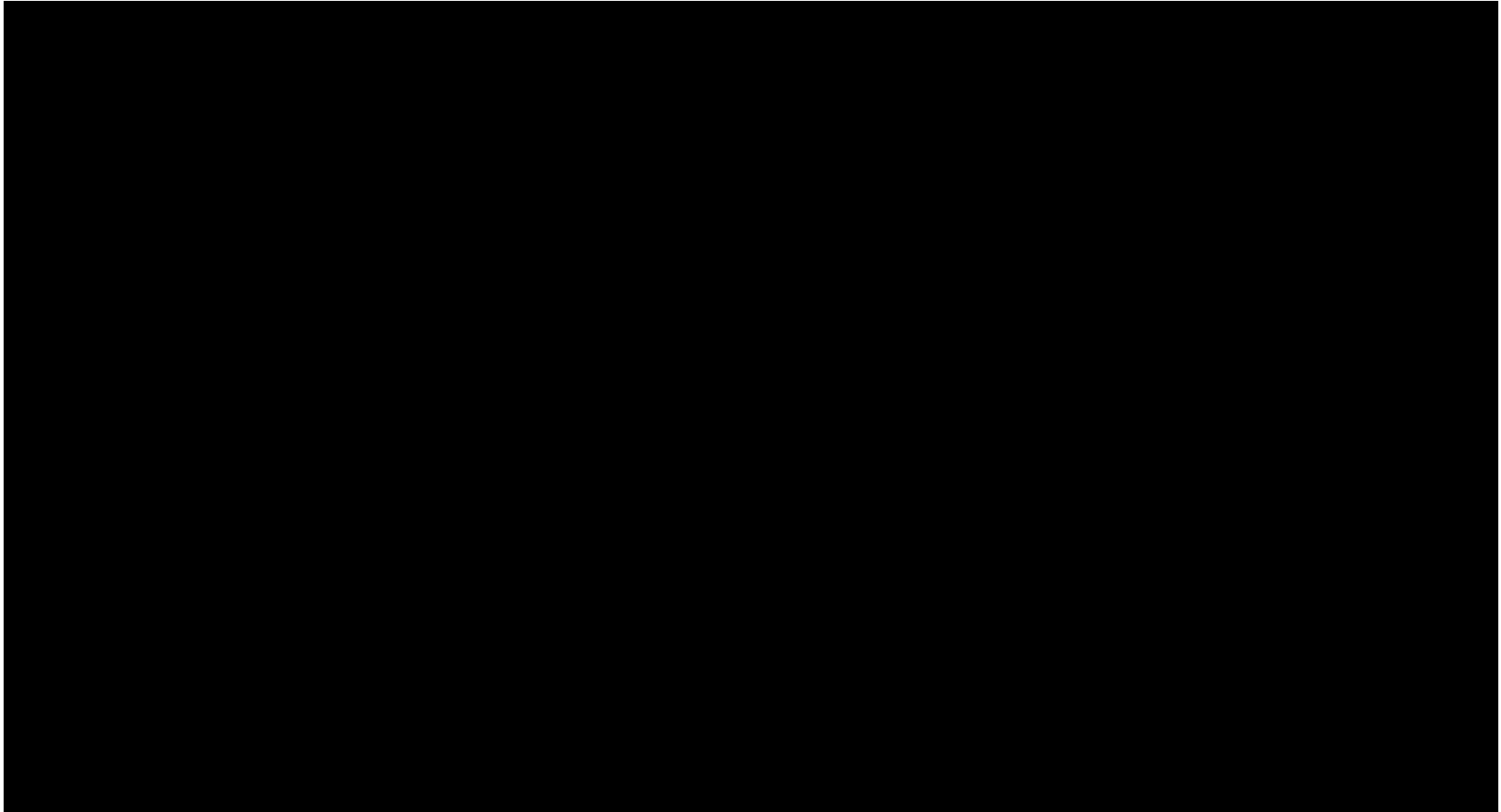
*Research Question #6: What effect do perceptions of backcountry skill level (skill) and self-reported knowledge of LNT principles (knowledge) have on respondents' perceived learning from the four dissemination strategies?*

Data were filtered so the following analyses were conducted only for individuals who had indicated exposure to the dissemination strategy under investigation. The correlation between self-reported skill level with backcountry travel (skill) and self-reported knowledge of LNT principles (knowledge) were significant in both samples (GNP  $r=.455$ ,  $p<.001$ , ONP  $r=.591$ ,  $p<.001$ ).

To examine the influence of the two predictors (skill and knowledge) on perceived learning from the four dissemination strategies, a series of regression equations were performed, results of which are presented in Table 5.5. Model one included the mean-centered predictor variables skill and knowledge against the four dependent variables (four individual equations). Model Two examined for the presence of power polynomials (curvilinear relationships) within the data. In an ideal situation, theory would suggest testing for nonlinearity (Jaccard & Turrisi, 2003). In the absence of theory however, empirical evidence such as visual inspection of residual scatterplots can be substituted (Cohen, et al., 2003). Evidence of moderation can be obtained through fitting a line to the residual scatterplot to examine the pattern or through the creation and entry (and significant contribution) of product terms into a hierarchical (stepwise) regression equation. Pictorially this relationship would be represented as a 'U' shaped line. Statistically this relationship is defined as a polynomial where the value of the independent variable depends on the level of the independent variable (Cohen, et al., 2003). Additionally, if the interaction is present, the  $\Delta R^2$  should be statistically significant ( $p < .05$ ) (Jaccard & Turrisi, 2003). To guard against multicollinearity, potentially a serious issue for regression based analyses particularly those with product terms (Jaccard & Turrisi, 2003), both tolerance and variance inflation factor (VIF) statistics were examined for each model. Results indicate that neither tolerance ( $GNP \geq .73$ ,  $ONP \geq .74$ ) or VIF ( $GNP \leq 1.37$ ,  $ONP \leq 1.51$ ) exceeded levels suggestive of multicollinearity (Cohen, et al., 2003).



Model One included only the mean-centered predictor variables skill and knowledge. For the GNP data, a significant and negative effect (beta coefficient) existed between 'skill' and what the respondent perceived learning across all four dependent variables (dissemination strategies). These results suggest that the higher the perceived skill of the respondent, the less they perceive learning from the dissemination strategy. All of these relationships were significant ( $p < .001$ ). Also within the GNP data, there were two significant relationships between perceived knowledge of LNT principles and the dependent variables 'review of park literature' and 'visiting the webpage' ( $p < .01$ ). However, each of these relationships were positive ( $\beta = .43$  &  $.83$ , respectively), indicating that as self-reported knowledge of LNT principles increases, so do perceptions regarding knowledge learned from the two dissemination strategies. The results from Model One within the ONP data were less confident. Perceived level of backcountry skill had a significant and negative relationship with the dependent variables 'amount learned from speaking to a ranger' and 'amount learned from visiting the ONP webpage' ( $p < .05$ ). Similar to the findings from the GNP data, these results suggest that the higher an individual perceives their backcountry skill to be, the less they perceive learning from the dissemination strategy. There were no significant relationships between self-reported knowledge of LNT principles and the three dependent variables in the ONP data.



Model Two included the squared polynomial terms holding the mean-centered IVs constant. None of the product terms in the ONP data were significant predictors of the three dependent variables. One product term was significant ( $p < .05$ ) within the GNP data (Table 5.3); the squared value of skill ( $\text{skill}^2$ ) predicting ‘amount learned from ranger’ ( $\beta = -.24$ ,  $t = -2.83$ ,  $p = .005$ ). Discovery of a significant effect allows testing of the simple slopes of the polynomial term skill. Simple slopes represent the regression of the dependent variable (amount perceived learning from a ranger regarding LNT) against specified values of the power polynomial (Cohen, et al., 2003). Interpreted, for those who perceive having relatively low levels of backcountry skill (one standard deviation below the mean) their slopes on the dependent variable ‘amount learned from a ranger’ decrease by  $(-) .132$  for every one unit increase in perceived skill level. For those who perceive having average levels of backcountry skill (at the mean), their slopes on the dependent variable ‘amount learned from a ranger’ decrease by  $(-) .566$  units for every one unit increase in perceived skill level. For those with relatively high perceived levels of backcountry skill, their slopes on the dependent variable are even steeper, decreasing by  $-1.001$  units for every one unit increase in perceived skill level.

### Discussion & Implications

The tenants of DT, coupled with findings from this investigation, provide insight into the current status and efficacy of the LNT Program in GNP and ONP. While the results are not necessarily transferable across all backcountry visitor education contexts, the following discussion provides those charged with dissemination of the LNT program

‘food for thought’ as they develop and refine educational intervention strategies to better meet management objectives.

At an awareness level, the LNT educational message appears to be highly diffused amongst the populations sampled. Well over 90% of respondents from both national parks report having heard of LNT prior to their participation in this investigation. Consistent with the construct of experience use history (Schreyer & Lime, 1984), those who have been participating in overnight backcountry camping longer have been aware of the program for longer periods of time. While this finding is not a revelation, it does suggest that LNT and the underlying stewardship ethic that the program promotes, is part of the ‘language’ or culture of overnight backcountry camping population in the units sampled.

Family and friends play an important role in both introducing the LNT program to other group members as well as serving as a primary source of LNT information. Approximately one out of every three respondents from each sample reported family and friends as their initial source of LNT information. One in five (18.7%) of GNP respondents and one in four (26.5%) ONP respondents reported family and friends as their primary source of LNT information. Thus, managers should target trip leaders with LNT information as well as encourage those leaders to help disseminate the LNT ethic amongst their group. Managers should also take note that for approximately 25% of respondents park dissemination strategies were their initial exposure to LNT. Thus, ranger staff must recognize that they have the charge of both providing introductory information about LNT to some, as well as additional or reinforcement information about

LNT to others. Somewhat surprising was the limited use of the internet by respondents to gain more information about LNT. Despite the proliferation of the internet in everyday life, it seems most respondents received information about LNT from other sources.

Other results of interest were the strong and positive attitudes regarding the global efficacy of the LNT program. The items presented in Table 5.1 were written to provide insight into respondents' global attitudes regarding the efficacy of LNT. On each of the three items presented, mean scores were above six on the seven point scale with relatively small levels of dispersion, lending support for the notion that respondents feel strongly about the efficacy of LNT. The *t*-test analysis on the composite measure of global LNT attitudes failed to illustrate significant differences between respondents in the two NPS Units. Thus, regardless of differences in age and overall overnight backcountry experience levels, global attitudes regarding the efficacy of the program in both parks appeared equivalent.

Backcountry visitors in the two parks reported having 'better than average' knowledge of LNT. These results suggest that the majority recognize they are not experts and are perhaps open to education and additional information regarding LNT. This is of particular importance when considering the relationship between knowledge of LNT and global attitudes regarding the efficacy of the program.

The correspondence between perceived knowledge of LNT and global attitudes regarding the efficacy of LNT was highly significant ( $p < .01$  in both samples) and positive in direction. Our post-hoc review of scatterplots suggests this relationship is also linear. For those charged with education and dissemination of LNT, this result has several

important implications.. First, the significant and positive correlation between these two variables suggest that a heightened knowledge of LNT led to more global support for the efficacy of the program. This finding of linearity between knowledge and global attitudes is also an important finding for managers as it indicates that, as individuals are further educated and their knowledge base regarding LNT increases, their support of LNT at a global level also continues to increase without diminishing or tailing off.

Marion and Reid (2007) asked the question: “(should) personal contacts, signs, brochures or computers be used to deliver messages to visitors” (p. 19-20)? While the answer is still not clear, our findings suggest that certain dissemination strategies are perceived by visitors as being more effective than others are. Significant discrepancies existed both within and between units regarding the proportion of respondents reached with the various dissemination strategies and how effective those strategies were perceived to be. For instance, the video presentation at GNP was viewed by over 86% of the sample while less than 42% reported visiting the GNP website to learn about LNT. For ONP, just over 50% of respondents reported either speaking with a ranger about LNT or reviewing printed literature about LNT. For the GNP sample, significant differences in perceived knowledge existed between those exposed and those not exposed to the dissemination strategies ‘speaking with a ranger’ and ‘visiting the GNP webpage’ ( $p < .05$ ). Thus, ranger contact and visiting the webpage does appear to significantly increase what individuals perceive they know regarding LNT principles. For the ONP sample, there were no significant mean differences between those exposed and those not exposed to the three dissemination strategies ( $p > .05$ ). This is also consistent with the

dissemination strategies utilized at ONP that are driven, in large part, by sheer volume of backcountry traffic through WIC. The sheer volume of people force ONP backcountry staff to rely heavily on printed literature to help disseminate the LNT message.

A number of interesting findings emerged when we investigated the effect perceived backcountry skill level and perceived knowledge of LNT plays on what respondents perceived learning from the four dissemination strategies. Primarily amongst them was the significant and negative relationship between backcountry travel skill level (skill) and what respondents' perceived level of learning from the four dissemination strategies (for relationships significant at  $p < .05$ ). This suggests an 'expert' mentality amongst respondents where the higher the respondents perceived skill, the less they perceive learning from dissemination strategies. These relationships were significant in all four of the GNP models and in two of the three ONP models. Further, the support for a power polynomial for GNP on the predictor 'skill' further supports the notion that the highest skilled travelers feel they learned the least from park education efforts. For those charged with dissemination of the LNT message, finding ways to connect with these (perceived) highly skilled individuals to reinforce proper backcountry practices will be challenging.

Finally, self-reported knowledge, in most cases, is not significantly related to what respondents perceive learning from the various dissemination strategies (note two of the seven relationships were significant, see Table 5.5). Therefore, while skill level appears to be a barrier to future learning, perceived knowledge level does not impede future learning from LNT dissemination strategies.

## Conclusion

The study was, by design, general in its approach and designed to provide a synoptic evaluation of the effectiveness of current diffusion strategies in two NPS Units and a broad introduction to the Diffusion of Innovations theoretical framework. Additional research, utilizing regression or structural equation modeling (SEM) techniques, could test the theoretical structure of DT for predicting adoption of LNT practices. Such a test would potentially examine the perceived attributes of LNT, the type of innovation-decision process, further explore the communication channels utilized to disseminate the message, investigate the social system, and evaluate varying levels of promotion plays on adoption (Rogers, 2003). Additionally, our outcome variables of choice were either the three-item composite measure assessing global attitudes regarding the LNT principles or a single-item self-reported knowledge variable. Other researchers investigating diffusion of the LNT program should consider more specific outcome measures. These could include self-reported or actual measures of behavior/behavioral intentions as they align with the LNT principles. Finally, this research has limited generalizability due to the study locations; future researchers utilizing DT to investigate LNT could examine users in other contexts such as state and local parks as well as USFS or other federal land users to better understand the degree of diffusion of the LNT message across a broader population.

In conclusion, our data suggests that awareness of the LNT message is highly diffused amongst backcountry travelers in the two NPS Units investigated and that a predominance of respondents have a positive general attitude toward the LNT program.



This suggests they are not only open to the message but also willing to change behavior if they learned their current actions were not acceptable. Park outreach strategies, including personnel, educational talks or videos, kiosks, and/or printed literature are for a substantial number of individuals surveyed their primary source of LNT information. Our data also suggest a multi-pronged diffusion strategy to disseminate best practices should utilize a variety of different media (video, face to face, signage, literature, and web). Finally, based on the significant and negative polynomial effect found regarding what GNP respondents perceived learning from a ranger, it would seem there is something of a ‘know-it-all’ syndrome transpiring.

## CHAPTER 6

### CONCLUSION

#### Chapter Overview

This chapter contains three primary sections. The first section reviews and summarizes key findings grouped by manuscript. However, unlike the previously presented manuscripts, this chapter focuses specifically on providing NPS managers and others charged with dissemination of the LNT message ‘food for thought.’ That is, this chapter provides general summary information and conclusions’ regarding what seems to be working, things that could be improved, and describes the psychological constructs that should be targeted if developing compliant LNT behaviors is the desired outcome of the LNT program. The second and third sections provide discussion of the limitations of the study and suggestions for future research.

#### Implications for Theory and Management

##### *Manuscript #1 & #2 (Chapters 3 & 4)*

Note: results from Manuscript #1 and #2 (Chapters 3 and 4, respectively) are presented together as both relied on the same variables. Additionally, implications for both theory and management are presented simultaneously as the results are so associated.

Researchers frequently use theory to provide a roadmap for exploring complex phenomenon. This is perhaps nowhere more important than in attempting to understand

and explain the nuances of human behavior. To help meet this end, this research utilized the Theory of Planned Behavior (TPB) (Ajzen, 1991), a widely used and robust theory for the prediction of human behavior, as a mechanism by which to explore the predictors of NPS backcountry visitors' behaviors. A review of the TPB is provided in Appendix B as well as in Manuscript #2 (Chapter 4). Briefly however, the theory contends that salient attitudes toward the outcome of a behavior, the influence of peers (subjective norms), and levels of perceived behavioral control determine one's intention to behave in a certain way. Intention is the best predictor of actual behavior.

Respondents' attitudes regarding the appropriateness of specific LNT practices were measured via a 15-item scale anchored from 1=very inappropriate to 7=very appropriate. Interestingly for park managers, while the results of the global measures of attitudes toward the LNT program indicated an overwhelmingly positive attitude toward the program and its effectiveness (see Manuscript #3, Chapter #5), attitudes toward specific recommended practices varied widely. This variability in responses suggests that certain recommended practices are not currently understood and/or supported.

For example, attitudes toward LNT principle 2 'travel and camp on durable surfaces' which measured attitudes regarding behaviors such as 'moving rocks and logs to make a camp more comfortable,' or 'walking around muddy spots on the trail' (both inappropriate) received both supportive and unsupportive responses. The first item, 'moving rocks and/or logs to make a campsite more comfortable' is viewed by 32.6% of GNP respondents as appropriate or very appropriate, 19% had a neutral response, and 48.3% felt the behavior was inappropriate or very inappropriate.

Respondents also appeared to be uncertain regarding the appropriateness of certain behaviors associated with LNT principle #3 ‘dispose of waste properly.’ The items that solicited the most variability (spread in scores) pertain to treatment of used toilet paper and urinating on vegetation. More specifically, 47% of GNP respondents and 53% of ONP respondents indicated that burying used toilet paper was an appropriate to very appropriate behavior. When queried about urinating on vegetation, 21% of GNP respondents and 26% of ONP respondents indicated this was a slightly appropriate to very appropriate behavior.

Similar results can be found involving attitudes associated with Principle #4, ‘minimize campfire impacts.’ Attitudes towards the behaviors ‘cooking over a campfire’ illustrated that 34% of GNP respondents and 33% of ONP respondents felt this was slightly to very appropriate behavior. The story is similar regarding attitudes regarding ‘building a fire ring if one is not present.’ Distribution of scores for this item showed that only 17% of GNP respondents and 23% of ONP respondents felt this was slightly too very appropriate behavior.

The 5<sup>th</sup> LNT principle ‘leave what you find’ was evaluated via the item ‘keeping a single small item like a rock or feather as a souvenir.’ Here too, responses varied. Nineteen percent of GNP respondents and 28% of ONP respondents indicated this as slightly appropriate to very appropriate.

Overall, the results discussed above regarding attitudes towards specific backcountry behaviors indicate that visitors are somewhat unsupportive and/or confused about the appropriateness of certain specific actions deemed important by the LNT

educational message for protecting natural and social resources. It would seem that many individuals, even those who claim to have ‘written the book’ on LNT principles, have attitudes toward current recommended practices and actual behaviors that stray far from what management would prefer. As a case in point: ONP respondents, which were the most experienced backcountry visitors, routinely reported less compliant attitudes than their GNP counterparts did. Perhaps this is a function of the evolution of the LNT principles over time. Recommended minimum-impact behaviors have undergone considerable changes through the mid to late 1990s. It is likely that respondents with many years of backcountry experience are familiar with the broad principles and learned specific backcountry practices one way and are simply ‘not up to speed’ with current promoted practices. Consequently, in designing educational interventions, strategists *must consider specificity of the behaviors in question in the educational message*. This research strongly suggests LNT outreach and programming should not only focus on the broad principles but should provide considerable effort explaining the SPECIFIC recommended practices and WHY they are important to perform (protection of resources, etc.).

Additionally, backcountry travelers are both open to education and supportive of the LNT idea. However, compliance likely varies widely. It is the position of the author that future LNT education efforts target that ‘why’ portion of the equation in an effort to influence salient attitudes toward the behavioral outcome in question. From a theoretical perspective, messages that serve to make the audience think in-depth about a subject are likely to be particularly effective (Petty, McMichael, & Brannon, 1992). In addition and

to provide further support for the position above, educating visitors (aiming to increase their knowledge) is generally viewed as an *ineffective* strategy for behavior modification (Ajzen, 1991). Instead, those charged with promotion of the LNT effort would be well served to target the belief structures that underpin human behavior (Ajzen, 1991; Iozzi, 1989). The first step in the construction of a message, therefore, requires a decision about the relevant primary beliefs, a process that cannot be left to intuition but must be guided by a model of the target's determinants. In short, targeting salient beliefs is of "paramount importance" (Ham & Krumpe, 1996, p. 18). Minimum-impact / LNT messages need to target salient attitudes and/or beliefs regarding appropriateness of behaviors in question.

The influences of peers (subjective norms) were evaluated via two statements. For example, on the item: 'Other members of my backcountry group would find it acceptable for me to bathe in a stream or lake,' 39% of GNP respondents and 48% of ONP respondents indicated slight to strongly agreeing with previously mentioned statement. The other norm item, 'Other members of my backcountry party would approve of me moving a few rocks or logs around to make camp more comfortable,' found 42% of GNP respondents and 68% of ONP respondents to range from slightly to strong agreement. These results suggest that normative pressure does in fact influence backcountry behaviors and such pressures need to be considered when developing and implementing LNT educational strategies. Thus, NPS managers should consider targeting trip leaders or those with the most experience with strategic educational messages as their opinions and actions appear to influence other member's behaviors.

Perceived Behavioral Control was explored via two similar yet different constructs, the level of perceived control respondents felt they have over their own LNT oriented behaviors (herein ‘control’), and the level of perceived difficulty respondents felt toward carrying out a variety of LNT oriented behaviors (herein ‘difficulty’). Each construct was measured with three items; control items anchored via a 7-point scale ranging from 1=not at all under my control to 7=completely under my control and difficulty items anchored on 1=very difficult to 7=very easy.

Results from the three items investigating ‘levels of control’ were quite similar across parks with limited variability in responses. For example, when asked to respond to the item ‘the way I act while in the backcountry of XNP is...’ 96% of GNP respondents and 98% of ONP respondents felt that their actions were largely under their control with mean scores ranging from 6.48 (GNP) to 6.59 (ONP) for respondents. This suggests that overnight visitors perceive themselves very much ‘in control’ of their behaviors.

Difficulty, as explored through the lens of Perceived Behavioral Control, received slightly more variation than control. For instance, approximately 94% of all respondents felt that following recommended minimum-impact/LNT camping guidelines to be relatively easy to very easy. However when asked about the ease of ‘carrying used toilet paper out of the backcountry of XNP,’ 69% of GNP respondents and 63% of ONP respondents believe this behavior to be relatively easy to very easy. These results indicate that visitors believe performing recommended NPS/LNT practices were not unreasonably difficult. In conclusion, the easier the individual perceives the behavior in question, the more likely they are to be compliant with a recommended LNT practice.

Thus, NPS management should attempt to remove *perceived* barriers to performing appropriate actions and emphasize the *ease* in complying with recommended LNT practices.

Respondents were also asked a series of four questions investigating their intentions to adhere to general LNT practices. Results indicated that across NPS Units, respondents were fairly unified and positive regarding their intentions to follow promoted LNT practices. When a composite was created (summing all items and dividing by 3) to assess overall intentions to follow LNT Practices, GNP respondents scored an average of 6.63 compared to 6.48 at ONP on a 7 point scale.

Structural equation modeling procedures of the variables within the TPB framework likewise provided a number of salient findings worthy of further discussion. Both data provided excellent fit to the hypothesized measurement model. However, when assessed via SEM, beta coefficients indicated different constructs influence intentions to comply with LNT practices depending on the NPS Unit. For park staff at ONP, targeting how prospective backcountry campers perceive the *difficulty* in carrying out recommended LNT practices is likely to be most influential in changing their behavioral intention to comply with recommended LNT practices. Conversely, at GNP, the results suggest that a combination of targeting perceived difficulty, knowledge of the principles, and subjective norms would be most beneficial to addressing behavioral intentions with recommended LNT practices. This finding is consistent with Hammitt and Cole's (1998) postulation that 'knowledge of minimum-impact (LNT) techniques...



are key components in managing backcountry recreation impacts and have been quite successful in reducing certain impacts' (pg. 186).

Of equal importance are the non-significant predictors. For the ONP sample, the data suggests that educational messages targeting attitudes toward the behavioral outcome, subjective norms, levels of perceived behavior control, and knowledge will be less influential on behavioral intentions to follow recommended LNT practices than addressing the difficulty visitors perceive in carrying out LNT practices. For the GNP sample, the data suggests that communication targeting salient attitudes toward LNT behaviors and levels of control will be less effective for changing backcountry recreationists' intentions to follow promoted LNT practices, than focusing education and communication on perceived difficulty, knowledge, and subjective norms regarding LNT behaviors.

Additionally, those charged with education dissemination at ONP are encouraged to consider the cross-loading between observed variable A-8 (having a campfire) and Factor 2a (General Backcountry Behaviors). This finding suggests that campfires are *part of the backcountry experience* and that if this behavior is something management wishes to change, the behavioral change strategy should be embedded within a larger discussion about general backcountry behaviors. Conversely, with the GNP sample, modeling the error-covariance between observed variables A-4 (camping with large groups (8 or more people) in the backcountry) and A-8 (having a campfire) proved a significant improvement to the model. This finding indicates that, for larger groups, campfires would seem to be an integral part of the experience. For managers, if fires are

an issue and is a behavior they wish to curb, targeting the belief structures of the individuals traveling in large groups is likely to be most effective.

*Manuscript #3 (Chapter 5 Diffusion of LNT Message)*

How do innovations, those ideas, practices, or objects that are new, become adopted into society? What causes one idea to rapidly become infused while others do not? Innovations succeed or fail for any number of reasons; Diffusion of Innovations Theory (DT) seeks to explain why an idea becomes adopted into society by exploring the variables that help account for adoption (Rogers, 2003). By better understanding the factors that influence adoption, more efficient strategies for introducing and diffusing innovations into society can be developed.

At an awareness level, the LNT educational message appears to be highly diffused amongst the populations sampled. When asked, ‘have you every heard of Leave No Trace?’ approximately 94% of GNP respondents and 98% of ONP respondents indicated ‘yes.’ Consistent with the construct of experience use history (Schreyer & Lime, 1984), those who have been participating in overnight backcountry camping longer have been aware of the LNT program for longer periods of time. While this finding is not a revelation, it does suggest that LNT is part of the ‘language’ of overnight backcountry camping population in the units sampled. However, awareness of the LNT program does not necessarily equate to positive attitudes toward specific recommended LNT behaviors or predict compliant backcountry behaviors. At its core, the LNT message is designed to help instill an environmental ethic amongst human powered outdoor recreationists. Promotion agents (NPS and otherwise) should remember that

attitude and behavior change are likely not to be affected by short rote information sessions in backcountry offices. Information alone likely does little to influence behaviors and ethics instillation is likely to be more a game of inches than of yards.

Family and friends play an important role in both introducing the LNT program to other group members as well as serving as a primary source of LNT information.

Respondents were asked to select, from amongst 9 categories, both their initial and primary sources for LNT information. Family and friends were the most popular initial source of LNT information. Twenty nine percent of GNP respondents and 28.1% of ONP respondents indicated family and friends as their initial source of LNT information.

Thus, managers should target trip leaders with LNT information as well as encourage those leaders to help disseminate the LNT ethic amongst their group. Managers should also take note that for approximately 25% of respondents, park dissemination strategies were their initial exposure to LNT. Thus, ranger staff must recognize that they have the charge of both providing introductory information about LNT to some, as well as additional or reinforcement information about LNT to others. Somewhat surprising was the limited use of the internet by respondents to gain more information about LNT.

Despite the proliferation of the internet in everyday life, it seems most respondents received information about LNT from other sources. When asked what has been their primary source of LNT information, 41.6% of GNP respondents and 34.6% of ONP respondents indicated that NPS outreach strategies (park personnel/talks and kiosks/literature) were their primary source of LNT information. Family and friends

were also an important primary source of LNT information as indicated by 18.6% of GNP respondents and 26.4% of ONP respondents.

Marion and Reid (2007) asked the question: “(should) personal contacts, signs, brochures or computers be used to deliver messages to visitors” (p. 19-20)? While the answer is still not clear, our findings suggest that certain dissemination strategies are perceived by visitors as being more effective than others are. To help answer this question, respondents were asked about their use of several NPS communication outreach strategies. Respondents indicated (yes or no) if they had: spoken with a ranger regarding LNT; watched a video regarding LNT; reviewed any printed NPS park material regarding LNT; or reviewed the webpage of the NPS Unit they planned to visit to learn about LNT. If they answered yes, they were asked to indicate, via a 7-point scale ranging from 0=nothing to 6=an extensive amount, how much they learned about LNT from the experience. Significant discrepancies existed both within and between units regarding the proportion of respondents reached with the various dissemination strategies and how effective those strategies were perceived to be. In GNP, the most popular source of LNT information was the backcountry video (86% of respondents indicated they watched the video), followed by a ranger (76.6% reported speaking with a ranger regarding LNT), printed material (72% reported reviewing printed material related to LNT), and finally the GNP website (41.4% reported visiting the GNP website to learn more about LNT). Visitor comments solicited on the final page of the questionnaire supported this point. A 35-year-old female from GNP remarked:

*Park ranger discussion when getting our permits was very informative.*

*Ranger was very knowledgeable and helpful. That was incredibly helpful information when preparing for our trip.*

In GNP, respondents indicated that they learned the most about LNT from the video (M=3.86), followed by printed material (M=3.59), the GNP website (M=3.54), and finally speaking with a ranger (M=3.31).

In ONP, the most popular source of LNT information was printed material (54.4% of respondents reported reviewing printed park media), followed by speaking with rangers (52.8%), and finally visiting the ONP website (20%). ONP does not use a video to disseminate LNT/backcountry camping information. In ONP, respondents indicated that they learned the most about LNT from the ONP website (M=3.33), followed by printed material (M=2.93), and then speaking with rangers (M=2.84). A 28-year-old female commented that:

*We were impressed by the organization of ONP. Before each of our overnight hikes, we spoke to rangers who emphasized Leave No Trace. At the Heart Lake Campsite on the High Divide Trail we were visited by a ranger at dinnertime. ONP is the best-organized national park I've ever visited.*

In conclusion, park outreach strategies, including personnel, educational talks or videos, kiosks, and/or printed literature are for a substantial number of individuals, their primary source of LNT information. Additionally, respondents perceive learning moderate amounts of LNT information from various NPS outreach efforts, irrespective of

the source or NPS unit. Thus, a multi-pronged diffusion strategy to disseminate best practices should utilize a variety of different media (video, face-to-face, signage, literature, and web). Additionally, certain outreach strategies appeared more effective depending on the emphasis placed on a particular source by management. For example, the source with the highest degree of ‘coverage’ from the two units was the informational video at GNP, with 86% of respondents reporting viewing this video. The video was also considered the most effective at promoting learning of LNT information by GNP respondents (mean score=3.86). Management at GNP requires all backcountry trip leaders to view the video and strongly encourages viewing by all overnight backcountry visitors. Ranger interaction with backcountry visitors is also heavily emphasized (primarily with trip planning); consequently, these two sources were highly used by GNP respondents. The role of popular media should also not be ignored for future dissemination of the LNT message. This type of media campaign is frequently described as ‘social marketing’ (Kotler & Zaltman, 1971). This could include links on webpage’s such as [www.recreation.gov](http://www.recreation.gov) , [www.gorp.com](http://www.gorp.com), and others. Additionally, popular written □ ADDIN EN.CITE <EndNote><Cite><Author>Arer, and others could reserve space to promotion of the message. In conclusion, NPS outreach strategies used to disseminate the LNT message were the most important primary source of LNT information.

When asked to self-report on their current knowledge of LNT Practices (7-point scale; 0=no knowledge, 1=very limited, 2=limited, 3=average, 4=above average, 5=extensive, 6=expert) 84% of GNP and 74% of ONP respondents classified their knowledge as ‘above average’ or greater. GNP respondents, who had the least

backcountry experience and who were the youngest (average age=36.2) of the two NPS units investigated, indicated the highest mean score on the LNT knowledge question ( $m=4.26$ ).

To address respondents' global perceptions of LNT as a program, respondents were asked to respond to four items anchored from 1=strongly disagree to 7=strongly agree. Overall, respondents showed universal support for the LNT program. For instance, 91.1% of GNP respondents and 92.7% of ONP respondents answered either '6' or '7' to the item 'it is important to use minimum-impact / LNT techniques when in the backcountry.' Respondents similarly indicated an overall strong willingness to modify their behaviors, as 92.4% of GNP respondents and 90.3% of ONP respondents indicated that they 'strongly agreed' to the item 'if I learned my actions in the backcountry damaged the environment I would change my behavior.' Likewise, a predominance of respondents indicated that they believe the LNT practices reduced environmental harm. Eighty-nine percent of GNP respondents and 90% of ONP respondents 'strongly disagreed' with the statement: "Minimum-impact/LNT techniques do not reduce the environmental harm caused by backcountry travel." Respondents had overwhelmingly positive global attitudes regarding the efficacy of the LNT visitor education program and receiving advice and direction from NPS personnel. This suggests they feel the program is worthwhile, is working, and they are open to changing behaviors if their behaviors were found to damage the environment. Global perceptions of the efficacy of the LNT message are very positive as the vast majority of respondents responded very favorably to items measuring global perceptions of the program. This suggests they are not only open

to the message but also quite willing to change behavior if they learned their current actions were not acceptable.

## Limitations

As with any study, there is any number of limitations to the generalizability of results. The following limitations of this proposed research are hereby recognized and a brief discussion of each follows:

1. This study utilized self-reported measures of overnight backcountry users within two NPS units. As with any self-reported approach, it must be recognized that social desirability and/or measurement bias could unduly influence results.
2. Generalizability of results – Outdoor recreational activities occur in a wide variety of geographic landscapes. Thus, caution must be exercised with making generalizations to other natural areas, particularly those which differ ecologically or operate under different management policies or guidelines (for example, land managed by agencies other than the National Park Service or areas not designated as wilderness or de facto wilderness).
3. The study utilized a cross-sectional design with primary data collected primarily from one location at each park during a time strategically selected to coincide with historical peak use. Future researchers are advised to select representative samples that cover the entire ‘season’ of backcountry use in the study areas.
4. The TPB is causal in direction yet our analysis in Chapter Four, like many TPB based studies, is correlational (Armitage & Conner, 2001; Sutton, 1998).



## Future Research Directions

This study begins to fill what previously has been a large void in the recreation ecology and backcountry management literature – assessing the efficacy and analyzing determinants of widely promoted LNT guidelines. However, the discussion of findings and limitations has highlighted a number of avenues for further research that should be considered by future researchers.

Development of quality items is both a science and an art. Future efforts to extend and improve the measurement of LNT related constructs should look to evaluate other, perhaps more germane items. Additionally, future research could also look to link salient backcountry attitudes (as measured via the BCVES-V1 or a subsequent version) to actual on ground behavior, thus addressing the criterion validity of the model. Do attitudes drive behaviors in backcountry contexts and if so to what extent? How effective are various education strategies and which are the most effective in modifying existing attitudes and subsequent behaviors?

Our modeling of variables within the TPB framework showed that the overall proportion of variance explained ranged from 27.4% (ONP) to 44.9% (GNP). Thus, the TPB appears to be quite robust in predicting compliance with recommended LNT practices. However, even our best model leaves more than half of the variance still *unaccounted* for, despite our use of SEM procedures to control for measurement error. Thus, future researchers are advised to address other measurement issues, particularly with refinement of indicator variables as well as the inclusion of other predictor variables. For instance, the items used to reflect the PBC-PC (F4) and Behavioral Intentions (F1)

Constructs were general and lacked a high level of specificity. Additional items, developed to cover both the breadth and detail of the LNT principles (Figure 1, Manuscript #2, Chapter #4), may prove to be more predictive of overall intentions to comply with recommended practices. Other predictor variables may also prove beneficial to our understanding of compliance with LNT principles. Place attachment and past behavior are two such variables which future researchers are encouraged to examine when examining determinants of human behavior regarding minimum-impact practices.

Additional research, utilizing regression or structural equation modeling (SEM) techniques, could test the theoretical structure of DT for predicting adoption of LNT practices. Such a test would potentially examine the perceived attributes of LNT, the type of innovation-decision process, further explore the communication channels utilized to disseminate the message, investigate the social system, and evaluate varying levels of promotion plays on adoption (Rogers, 2003).

## Conclusion

National Park Service managers and others who utilize the LNT message to help protect resources and meet management objectives should consider the theoretical frameworks used in this study as a road map for understanding and predicting visitor behaviors. For example, if, toilet paper ‘blooms’ are a problem that management wishes to address through the LNT message, then the author of this dissertation recommends a progression similar to the following. Utilizing the TPB framework, managers should

identify salient attitudes regarding disposal of toilet paper at the area in question, the normative attitudes (peer pressure) toward the disposal of toilet paper, and finally the perceived control an individual feels toward performing a preferred behavior. If the management finds that disposing toilet paper is viewed as acceptable by visitors, then messages can be created and delivered (face to face, signage, webpage, video, and/or other) that address the ‘why not’ of this behavior as well as providing examples of preferred alternative behaviors that protect park resources. Such messages can and should target salient attitudes, normative influence (peers), and/or perceived control (with a focus on difficulty) regarding compliance.

The author of this dissertation also believes NPS professionals should move LNT from a general education program to a strategic communication effort. Strategic communication was described by Ham as taking environmental communication (here promotion of the LNT message) from what he described as a ‘loving/respecting nature’ to a full-fledged systematic and planned persuasive communication effort (1997). A strategic communication effort rests on the ability of communication to target explicit behaviors (Byers, 1996). It moves general environmental communication (like a ranger reciting the LNT steps) to a full-fledged persuasive communication effort designed to target specific behaviors and to change or modify them to help meet management objectives. Undertaking a persuasive communication effort necessitates the explicit acknowledgement of desired outcomes and the subsequent establishment of a variety of mechanisms to help reach them. Under a strategic communication effort, specific outcomes could include behavioral, cognitive, and attitudinal components.

Why change the promotion efforts of LNT, which is a generally rote learning strategy utilizing a variety of formats, to a strategic communication effort? Firstly, research has continually proven the lack of a linear relationship between knowledge and behaviors. Individuals may know what the correct behavior is – however, they often fail to exhibit it. Secondly, environmental education has been criticized as lacking specificity (Kohl, 2005). A strategic effort designed specifically to promote the LNT message can help overcome this potential shortcoming by focusing attention on specific goals and objectives. Thirdly, a strategic communication effort can help move audiences from rote learning to meaningful learning/elaboration. Meaningful learning is typified by the promotion of transfer, when “a person uses knowledge from previous experience to help learn something new” (Mayer, 2002a, p. 5). Meaningful learning can help individuals to create meaning from their experiences, analyze information to understand its many parts, evaluate, and finally take what they have learned to create something new (Mayer, 2002a). By explicitly recognizing a number of targeted goals, environmental communicators can help design messages that elicit elaboration by provoking the audience to think rather than just presenting facts (Ham, 2007a). Finally, implementing a strategic communication effort can assist in evaluating the outcome of that effort. Because implementing a strategic communication effort relies on the explicit stating of goals and objectives, we can design education and evaluation strategies to ascertain if selected outcomes are actually being met.

## APPENDICES

## APPENDIX A

### LITERATURE REVIEW

#### Introduction to the Literature Review

Someone much more intelligent than I once said you cannot move forward unless you know where you have been. It is in this spirit that this literature review addresses four sequential topics, that, when taken together, deliver the reader from our early American approach to nature to the jumping off point of this dissertation; the use of LNT as a primary visitor management tool in protected area management. To meet this end, this review first provides a synopsis of the evolution of the American conservation movement. Herein the reader will find reference to the significant individuals and thoughts that stimulated the development of the philosophical ideals that have guided land management principles to where they are today. Next, this appendix provides discussion regarding approaches to natural resource management with particular focus on the human dimension of the equation. The third portion of this review addresses the viability of education as a resource protection tool in public land management settings. The fourth and final portion of this review addresses the development and current standing of the interagency LNT Visitor Education Program including the development, evolution, and empirical evaluations of the program.

## Synopsis of the American Environmental Conservation Movement

In the United States, the four primary federal land management agencies are directly responsible for approximately 30% of our total land mass, many acres of which are protected under stringent management policies including the Wilderness Act ("Wilderness Act," 1964) and Wild and Scenic Rivers Act ("Wild and Scenic Rivers Act," 1968). Yet this was not always the case. In our brief 200+ year history, our approach to our natural resources has at times been destructive, exploitive, and frequently guided exclusively by economic incentives. Thus, this initial section of the literature review of this dissertation traces how we as a society have evolved in our thinking and practices concerning the larger environment we all share.

### *Overabundance & Exploitation*

Imagine for a moment standing near Jamestown, Virginia in the early to mid-1600s. The land and the resources that would have surrounded you – dense forests, streams, lakes, rivers, elk, deer, and turkey – must have seemed endless. Additionally, being versed in the practices of Christianity you regarded the lands that surround you as wilderness. Moreover, as a good Christian you believe that wilderness should be conquered, controlled, and managed so that its benefits can be realized. Wealth in continental Europe was demonstrated through the amount of land owned. Here in the new world, land was virtually free for the taking. Any individual willing to take up the axe and the hoe, put a plow to the soil, could own land and pursue the American dream.

Thus, the American relationship with nature was born under the premise of man conquering nature (Nash, 2001). When a President Jefferson purchased the Louisiana

Territory from the French in the early 1800s and commissioned Lewis and Clark to explore the new territory, the motivation was economic. Land and resources were commodities, possession of such commodities constituted wealth, and being recently free from authoritative British rule, Americans could use all of the wealth they could acquire. The 1803/04 Lewis and Clark expedition fostered a new era of American's interaction with nature. It represents an awakening and realization that served to shift approaches to natural resources from a '*wow – we have a lot of land and resources*' (overabundance) to one of '*wow – how can we best use this newfound land and resources to our benefit*' (exploitation). Stewart Udell called it the "superabundance attitude." It was during these formative years that clear cutting, market hunting, and other such ecologically disastrous practices were not just practiced, but undertaken with an almost religious zealously.

#### *Exploitation to Conservation*

What is conservation and how did American society move from our exploitive roots to conservation and eventually to environmentalism? Gifford Pinchot, regarded by many as the father of conservation, is credited with coining the phrase (conservation is) "the greatest good, for the greatest many, for the greatest amount of time." A conservation approach is largely anthropocentric – the resource has utility to humanity – and thus should be managed and used as such (Gagnon-Thompson & Barton, 1994). The paradigm shift from exploitation to conservation also posits that control, regulation, and policies to protect the long-term viability of the resource are essential.

The transition to a conservation mindset did not happen overnight, and is so often the case it began slowly with the writing and musing of a few key individuals. Legislator



and lawyer George Marsh from Vermont delivered several key speeches and published a book *Man and Nature* in the mid-1800s that examined the negative externalities of humans' interaction with nature. The writings of *Nature* by Emerson and *Walden* from Thoreau (among others), gave birth to transcendentalism, the notion that man is part of a larger biological system. Thoreau also advocated for the establishment of local parks from 500 to 1000 acres in size where individuals could return to nature. Through the mid to late 1800s the conservation movement continued to gain strength and recognition at the public and legislative levels (both state and federal). It was during this period that Hot Springs, Arkansas was placed under federal control to protect this unique cultural resource from development. The nation also witnessed the development of urban parks, the most recognizable example New York City's Central Park. Up until the mid-1800s, NYC continued to grow, fueled by the beginnings of the Industrial Revolution and its proximity to both the Hudson River and Atlantic Ocean. In what can only be regarded as extraordinary vision of city leaders, Fredrick Law Olmstead was commissioned in the mid-1850s to design an urban park. His vision became Central Park – a sprawling and often copied urban park that included design features such as running trails, water, woods, land contours, large open areas, and amphitheaters.

### *Conservation to Preservation*

This review differentiates between conservation and preservation by addressing each topic as two separate philosophical approaches to natural resource management. Earlier, conservation was defined as the 'wise-use' of resources, or use that provides 'the greatest good, for the greatest many, for the greatest amount of time.' Philosophically,

preservation is best defined by words like in perpetuity, infinity, forever. A preservationist has an ecocentric or biocentric approach: the resource has value beyond that which can be defined by the market (Gagnon-Thompson & Barton, 1994). A preservationist views the resource as having intangible values; the resource is important for reasons including socializing, spirituality, solitude, and for reconnecting with nature. In short, *nature is valuable into and of itself*.

Where did the notion of preservation come from? Many trace the preservation approach to natural resource management back to at least to the transcendental philosophy posited by Emerson and Thoreau. Thoreau wrote some 150 years ago “in wilderness is the preservation of the world” and this became a rallying point for the preservation movement. The writings of Emerson and Thoreau were also influential to a young John Muir, a poor farm boy from Wisconsin. Muir’s rise to preservation fame was somewhat innocuous and deserves discussion. Sometime in the late 1800s, he lost sight in one eye due to a manufacturing accident. Soon thereafter, his other eye shut down leaving Muir sightless for several weeks. When his eyesight returned in his undamaged eye, Muir shrugged off society and set out to both see and experience the natural world. His travels eventually lead him to the Yosemite Valley of California where he quickly fell in love with spectacular nature of the place. He began to write and publish and befriended President Roosevelt who was equally enamored with the outside world.

#### *Differentiating between Conservation and Preservation*

Now that the philosophical differences between conservation and preservation have been described and its most influential players introduced (Pinchot and Muir,

respectively), it is beneficial to examine the single event that will forever be remembered as the incident that would forever divide these two beliefs; the controversy over John Muir's beloved Hetch Hetchy Valley in Yosemite National Park (Nash, 2001). In the early 1900s, a burgeoning San Francisco lobbied for the right to dam the valley to provide drinking water to the city. Battle lines were quickly drawn. On one side was the conservation camp – arguing that utilitarian usage of resources was not just acceptable, but it was downright necessary. On the other side of the controversy were the preservationists, lead by John Muir, who were horrified at the possibility of losing such a beautiful area. The issue caught the attention of the public and Hetch Hetchy quickly became thrust to the forefront of the nation. In the end, Roosevelt sided with Pinchot and in 1913 the Hetch Hetchy Dam was completed, drowning the valley.

It bears discussion that even though the fight to save the Hetch Hetchy valley was lost, the event served to cement the distinction between preservation and conservation. It is also interesting to examine the exact beginning of conservation and preservation as *movements*. Conservation is frequently linked back to Gifford Pinchot who advanced the notion of conservation through his connections. It was an institutional approach to diffusion of the idea. Muir, who is generally considered the grandfather of the preservation movement, used a more grassroots approach to diffuse his idea amongst the American public. It was at this time that we also see several non-governmental organizations (NGOs) come on the scene in support of the preservation movement. Examples include John Audubon starting the Audubon Society in protection of birds, the Sierra Club advocating for protection of wilderness and other natural areas (there were

not any federally designated wilderness until 1964), and the Appalachian Mountain Club of Boston in protection of the White Mountains of New Hampshire.

Natural resource management in America today still largely falls under either the conservation or preservation approaches outlined above. The US Forest Service (USFS) and National Park Service (NPS) are, respectively, the two federal agencies that typify these two philosophical approaches to natural resource management. Created in 1905 and headed initially by Pinchot, the USFS manages some 193 million acres of forests and grasslands in 44 US States and Puerto Rico. If management of National Forest typifies conservation, then the NPS approach to parks and protected areas epitomizes preservation. National parks are said to represent this nations jewels – protected forever from resource extraction and other such non-compatible uses. In 1916, after four years of debate, the National Park Service was created under the Department of the Interior. The challenges faced by this young agency were complex, many of which can be directly linked to the dual mission of the NPS. That is, the NPS is responsible for both protection *and* providing for visitor enjoyment. Indeed, the somewhat paradoxical mission statement of the NPS is to:

*"...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*

The subsequent section overviews the complex challenges facing recreation resource managers and philosophical approaches for managing the human portion of the equation.

## Recreation Resource Management

The four primary federal land management agencies in this country (USFS, Bureau of Land Management, US Fish & Wildlife Service, and NPS) have traditionally approached resource management through the lens of natural or biological science (Carr, 1995). While adept at finding technical solutions to technical and biological problems, this approach has largely ignored the human dimension of resource management equation. Within the past quarter century however, this focus has shifted. Perhaps the most visual representation of this shift occurred when former USFS Chief Robertson announced a change to ecosystem management. Ecosystem management “*recognizes that people are part of ecosystems, that people’s pursuits of past, present, and future desires, needs and values (including perceptions, beliefs, attitudes, and behaviors) have and will continue to influence ecosystems and that ecosystem management must include considerations of the physical, emotional, mental, spiritual, social, cultural and economic well-being of people and communities*” (Carr, 1995, p. 20 from USDA Forest Service 1994). By focusing on the human dimension and impacts caused by man in nature, the USFS has taken a more holistic approach to both identifying problems and finding solutions. Because this dissertation addressees human behavior and attitudes, the

remainder of this literature review focuses on human dimension of natural resource management.

### *Human Dimension of Natural Resources Management*

A primary challenge to effective protected area management is managing the human element in a sustainable fashion without negatively impeding on the visitors experience. Kuo described visitor management within park and protected area contexts as “an ongoing process to reconcile the potentially competing needs of the visitor, the place and the host community” (2002, p. 88). Visitors to a park or protected area can be viewed as acting in a state of continual interaction with the environment that surrounds them. This interaction, an externality of the visit, can serve to sustain, degrade, or have zero impact on the environment. Interactions can take the form of human/wildlife interface, respect towards other visitors, off-trail hiking, and improper camping practices, amongst many others. Behaviors that sustain or have zero impact on the environment are of little concern to managers. Conversely, behaviors that negatively affect the environment are of large concern and can either be ecological, social, or both (Ham & Krumpe, 1996). This problem is accentuated as empirical investigations have continually exposed how even nominal use can accentuate resource degradation (Leung & Marion, 2000) and cumulative impacts can be substantial (Hammitt & Cole, 1998). It is no surprise then that recreation has become, and will continue to be, a significant management consideration for federal land managers in policy formulation and implementation.

### *Recreation & Recreation Impacts on Public Lands*

The USFS reports that visitors to Forest Service managed lands grew some 18 times from 1946 through 2000 when an estimated 214 million people visited Forest Service administered lands. Wilderness and backcountry recreation has not been immune to this growing phenomenon of recreational use as popularity of backcountry recreation boomed through the 1960s – 1970s before leveling off in the 1980s. The trend regarding wilderness use is again increasing, predicted to rise 2% per year to a projected 23.5 million visitor days by 2010 (Moore & Driver, 2005). Another study illustrated that participation rates in a variety of outdoor recreation activities increased 10% between 1998 and 1999 (Bricker & Kerstetter, 2002). The attractiveness of backpacking specifically is expected to rise some 155% by 2040 and use by day hikers may increase even more (Chavez, 2000). This increasing trend of users is also predicted to include a more diverse population (Moore & Driver, 2005).

Impacts from recreation are an inevitable consequence of the utilization of that resource. This field of study, driven in part by increases in overall use, has been termed *Recreation Ecology*, a “field of study that examines, assesses, monitors visitor impacts, typically to protected natural areas, and their relationships to influential factors” (Leung & Marion, 2000, p. 23). Indeed, ongoing research has shown wilderness visitors are impacting resources and that these impacts are occurring in pristine and wilderness areas (Monz, 1994). However, it is important to realize that not all impacts are negative. Moore and Driver differentiate between negative *and* positive recreation impacts (2005). A host of positive impacts (or benefits) can be obtained from wilderness, including

achievement, self-efficacy, etc. It is beyond the scope of this review to discuss these positive impacts as this dissertation focuses on the effectiveness of the LNT message to curtail *negative* recreation impacts.

Leung and Marion define negative ecological recreation impacts as, “any undesirable visitor-related biophysical change in the wilderness resource” (2000, p. 23). Another recent definition of negative recreation impacts is, “any damage, intentional or otherwise, that results from outdoor recreation use” (Moore & Driver, 2005, p. 209). These negative impacts have been further divided into two categories, wilderness travelers interacting with each other (sociological) (Moore & Driver, 2005) and wilderness visitors interacting with the natural environment (ecological) (Hammitt & Cole, 1998; Leung & Marion, 2000). Hammitt and Cole (1998) discuss ecological impacts in their book, *Backcountry Recreation: Ecology and Management*. Within this text, the authors discuss ecologically oriented resource problems and issues that stem from recreational use of wilderness. The book discusses four components of resources that are impacted by recreational use; soil, vegetation, wildlife, and water (Hammitt & Cole, 1998). In a state-of-review paper Leung and Marion (2000) presented a synopsis of Hammitt and Cole’s recreation impacts in a table form (Table A.1).



Table A.1

*Common Forms of Negative Recreation Impacts in Wilderness (Leung & Marion, 2000)*

	Ecological Component			
	Soil	Vegetation	Wildlife	Water
Direct Effects	Soil compaction	Reduced height and vigor	Habitat alteration	Introduction of exotic species
	Loss of organic litter	Loss of vegetation ground cover	Loss of habitats	Increased turbidity
	Loss of mineral soil	Loss of fragile species	Introduction of exotic species	Increased nutrient inputs
		Loss of trees and shrubs	Wildlife harassment	Increased levels of pathogenic bacteria
		Tree trunk damage	Modification of wildlife behavior	Altered water quality
		Introduction of exotic species	Displacement from food, water and	
Indirect/ Derivative	Reduced soil moisture	Composition change	Reduced health and fitness	Reduced health of aquatic ecosystems
	Reduced soil pore space	Altered microclimate	Reduced reproduction rates	Composition change
	Accelerated soil erosion	Accelerated soil erosion	Increased mortality	Excessive algal growth
	Altered soil microbial activities		Composition change	

As mentioned above, negative impacts to recreation can be both ecological and/or sociological. Examples of negative sociological impacts in wilderness include conflict, crowding, visual or auditory disruptions of the experience among others. Moore and Driver summarized negative recreational impacts within their text through a discussion of five general characteristics (2005). They describe how (1) all impacts are interrelated with each other and that (2) impact levels are related to use, however, depending on the environment the impact may vary drastically. They also discuss how (3) tolerance levels may vary widely depending on the particular type of impact and that different influences

are (4) specific to particular activities and (5) specific to particular sites. The following section describes how education can be utilized to help address negative ecological and sociological impacts of recreationists.

#### *Problem Behaviors in Natural Environments*

Hendee et. al. (1990) and later Manning (2003) put forth a typology of five classifications of visitor induced problems behaviors; illegal, careless, unskilled, uninformed, and unavoidable. Illegal actions include behaviors such as theft or operation of motorized vehicles in areas deemed off limits, etc (Hendee & Dawson, 2002). Careless actions include littering or loud, obnoxious behavior. Marion and Reed described careless actions as “done without full consideration for their effect on the resource or other people” (Marion & Reid, 2007, p. 9). Unskilled problem behaviors could include not disposing of human waste appropriately, large campfires, or poor campsite selection. Uninformed problem behaviors can be exemplified through not stepping off the trail when encountering pack animals, using large dead snags for firewood, or camping in close proximity to another party. Finally, unavoidable problem behaviors may include destruction of ground cover or erosion of a trail.

Adopted from Manning (2003), Table A.2 describes a variety of visitor induced problems and the applicability of information/education (including LNT) to address such problems. For the first two problem behaviors (unavoidable and illegal behaviors) Manning (2003) suggest education will have limited effectiveness to curb negative behaviors. Careless, unskilled, and uninformed actions were however, identified as to having moderate to very high chances of being influenced by education/information

interventions (Manning, 2003). The extent to the effectiveness of persuasive communication to curtail these behaviors is however “likely to depend largely on the type of impact, the behavior involved and the motives for the behavior” (Roggenbuck, 1992, p. 162).

Table A.2  
*Application of Information/Education to Wilderness Management Problems (Manning, 2003)*

Type of Problem	Example	Potential Effectiveness of Information/Education
Illegal actions	Theft of Indian artifacts; use of wilderness by motorized off-road vehicles	Low
Careless actions	Littering; shouting	Moderate
Unskilled actions	Selecting improper campsites; building improper campfire	High
Uninformed actions	Using dead snags for firewood; camping in sight or sound of another group	Very high
Unavoidable actions	Disposing of human waste; trampling ground cover vegetation at campsites	Low

### *Recreation Ecology & Backcountry Visitor Studies*

To provide an overview of past studies addressing backcountry recreation impacts and visitor attitudes/behaviors, past research efforts were categorized into three groups: 1) visitor behavior in backcountry, 2) visitor induced resource impacts, and 3) visitor education strategies.

A variety of research efforts have explored visitor behaviors in backcountry environments. Christensen and Cole (1999) examined preferences of wilderness visitors in eight different US wildernesses regarding campsite locations (proximity to lakes) and

use of cook stoves while camping. Still others have investigated human waste disposal (Cilimburg, et al., 2000), campfire impacts (Reid & Marion, 2005), leaving what is found (Widner & Roggenbuck, 2000), and consideration of other visitors (Manning & Valliere, 2001).

A significant body of research also exists assessing the impact of visitors on the landscape, or what is termed ‘recreation ecology’ (Hammitt & Cole, 1998; Leung & Marion, 2000). Studies have examined damage to trees, campfire impacts, loss of ground-cover, trampling effects, and soil compaction among other biophysical impacts (Cole, 1992; Cole & Spildie, 1998; Leung & Marion, 2000). As discussed by Daniels & Marion (2005), such studies have largely discovered an ‘asymptotic use-impact relationship,’ meaning the majority of impact occurs initially and cumulative impacts begin to level over time (see also Hammitt & Cole, 1998).

Research examining the efficacy of visitor education to reduce impacts in protected area contexts can be traced back to at least Fazio’s (1979) study of camping practices at Rocky Mountain National Park. Indeed, there are volumes of literature dedicated to examining the efficacy of visitor education in park and protected area contexts (for a review see Manning, 2003). The effect of information on visitor use patterns has been explored by a number of researchers (Krumpe & Brown, 1982; Lime & Lucas, 1977; Roggenbuck & Berrier, 1982) with Manning (2003) concluding information to address use patterns is particularly effective if available during trip planning. Visitor knowledge studies are reviewed in the ‘LNT Investigations’ section. After reviewing studies by Manfredo, Yuan, and McGuire (1992) and Bright et. al., (1993) amongst

others, Manning (2003) concluded education can effectively modify visitor attitudes. Finally, it is acknowledged that depreciative behavior can be effectively addressed via education (Manning, 2003). These studies solidify the assumption that education is an effective visitor management strategy.

## Education as a Recreation Management Tool

### *Approaches to Recreation Management in Protected Areas*

Several authors have posited that there are two overarching mechanisms for managing the human element in park and protected areas, direct (hard or regulatory) and indirect (soft or nonregulatory) (Hendee, et al., 1990; McCool & Christensen, 1996). Direct visitor management strategies includes the employment of regulations, sanctions, and/or physical management such as barriers, boardwalks or fencing (Duncan & Martin, 2002; Kuo, 2002). Indirect visitor management includes education and/or interpretation efforts (Duncan & Martin, 2002). The use of education is considered ‘light handed’ as it is perceived to not be negative to the visitors experience and instead often heightens it. Indeed, research has shown education to be preferred by both managers (Washburne & Cole, 1983) and visitors (Hendee, et al., 1990) in protected area contexts over more direct methods such as sanctions or regulations. In fact, education is regarded as the most appropriate visitor management strategy in wilderness and other protected area settings and is preferred over enforcement for both philosophical and practical grounds (Hendee & Dawson, 2002; Passineau, et al., 1994). The oft-cited quote from former USFS Chief Max Peterson (1985) serves to highlight the position of our nation’s land managers

regarding the preference for education over enforcement to obtaining compliance in wilderness: “*Wilderness management is 80-90 percent education and information and 10 percent regulation.*”

A variety of minimum-impact visitor education programs and strategies have been developed over the past 30 years to help curtail the impacts of recreationists on backcountry, including LNT, Codes of Conduct, and Guidelines for Tourists (Marion & Reid, 2007). In this application, education (used synonymously here with interpretation) can provide managers tactics to promote conservation/stewardship behaviors (Hendee, et al., 1990; Roggenbuck & Berrier, 1982), raise awareness (Ballantyne & Uzzell, 1999), lessen instances of depreciative behavior (Kimmel, 1999), increase knowledge (Cole, et al., 1997), influence attitudes, and enhance the experience (Ham, 1992)

#### *Approaches to Persuasion*

There are three general psychological approaches to influencing human behavior: applied behavioral analysis, central route to persuasion, and peripheral route to persuasion (Manfredo & Bright, 1991; Roggenbuck, 1992). It bears note that “each of these approaches has a different foundation in learning psychology, each accomplishes persuasion in a different manner, and each is appropriate or inappropriate for certain recreation settings, audiences and problems (Roggenbuck, 1992, p. 170).

Applied behavioral analysis approach to persuasive communication focuses directly on the behavior in question rather than the underlying attitude or belief driving the behavior. It is by all accounts a direct approach to visitor management. Reward those who behave appropriately and punish those who do not. As posited by

Roggenbuck (1992), this particular approach to persuasion often falls short when applied to low-impact situations because it fails to recognize the ‘whys.’ In addition, applied behavioral analysis does not address values and attitudes and so even if compliance is reached in the short-term it cannot be expected to last (Roggenbuck, 1992).

Under the central route to persuasion model, a carefully constructed message is provided to an attentive recipient who then integrates the message into their belief system. According to the model, the outcome of this process is an informed and educated visitor who is motivated to comply with recommended practices based on internal beliefs rather than extrinsic influence (Roggenbuck, 1992). It is recognized however, that in order for the central route to persuasion to occur, the recipient must be motivated to pay attention to the message, have the ability to understand, accept the message, and then be able to act out the recommended practices. Finally, research has shown that the most willing recipients of new messages via the central route are low-knowledge or first time visitors (Manfredo & Bright, 1991; Roggenbuck, 1992).

The final path of persuasive communication is termed the peripheral route (Roggenbuck, 1992). Under this model, the recipient is considered unable to process the information and therefore the source of the message becomes most important. Manning (2003), when discussing peripheral route to communication, posits that “messages from sources considered by visitors to be authoritative or powerful may influence behavior, while other messages may be ignored” (p. 21). The recipient decides under this model to accept or rejects the message based on qualities of the sender. Like the applied

behavioral analysis approach, the peripheral approach does not address values and attitudes so it cannot be expected to have a long-lasting impact (Roggenbuck, 1992).

*Outcomes of Persuasion: Influencing Knowledge, Attitudes, & Behavior*

Within the realm of natural resource management, general classifications of outcomes that managers desire to change via education (or what Ajzen described as target variables) are attitudes, knowledge, and/or behavior (1992). Attitudes are defined as the “psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (Eagly & Chaiken, 1993, p. 1). Knowledge refers to information we possess, or ‘what we know.’ Behavior is an umbrella term used to describe any number of actions a person may undertake. For this review, it is more applicable to focus on what have been termed conservation behaviors, aka environmentalism. Stern described such behaviors as “the propensity to take actions with pro-environmental intent” (2000, p. 411). Thus, environmentalism is behavior that is ecological in its motivation. Environmentalism becomes realized through behaviors that strive to protect the integrity of the resource by promoting sustainability. This manifestation of environmentalism is sometimes referred to as an environmental ethic. In a general definition, an environmental ethic is evident through such behaviors as recycling, carpooling, minimum-impact camping, utilizing public or alternative means of transportation, installation of energy efficient household utilities, etc. In park and protected areas, the exemplification of an environmental ethic could include following prescribed Leave No Trace behaviors, practicing catch and release while fishing among others.



### *Use of Education/Interpretation in Protected Area Management*

As indicated at the beginning of this section two general classifications of education in protected area management were introduced: environmental education (EE) and environmental interpretation (EI). Differentiating between the two is largely a matter of the formality of the situation as the desired outcomes are largely indistinguishable. However, environmental education is generally assumed to transpire in more traditional environments with audiences that are frequently school-based (Ham & Krumpe, 1996) while interpretation, which the remainder of this manuscript addresses, is geared towards audiences outside of a typical classroom environment (Ham & Krumpe, 1996).

Weiler & Davis described interpretation as “an educational, illustrative and entertaining activity which aims at providing the visitor with an insight into the interrelationships of the various resources and system comprising the natural environment by first-hand experience” (1993, p. 93). Another definition describes interpretation as a “process of simplifying information and complicated ideas and sharing them with a more general audience” (Youngentob & Hostetler, 2003, p. 1). Kohl provided discourse that if interpretation is viewed as a broad communication strategy (as oppose to just fostering awareness and appreciation) then it has application for addressing park management objectives, conservation behaviors, and environmental communication (2005). These definitions and purposes of interpretation are interesting as they represent a departure of interpretation from its traditional ‘awareness’ and ‘appreciation’ roots to a more specific and strategic function, a topic that will be further explored shortly. For this dissertation,

Ham's definition of interpretation as the "communication side of resource management" is accurate (Ham, 1999, p. 2).

There are any number of outcomes that interpretation aspires (Ham, 1992). Tilden posited that EI should provoke curiosity, relate to visitors, and reveal meaning (1957). Ham posited that interpretation should 'provoke the audience to think' (psychologist use the term 'elaborate') (Ham, In draft, pp. 4, Chapter 4). Interpretation also aspires to enhance the visitor's experience (Ham, 2002) by connecting the audience to the subject of the interpretive effort (Youngentob & Hostetler, 2003). Interpretation should be rewarding to the visitor (Ham, 2002) and seek to create a heightened sense of awareness (Ham & Krumpe, 1996). Loomis indicated that interpretation should be designed and implemented to promote cognition (1996) while others have indicated interpretation should foster heightened levels cultural awareness (Ham, 2002), awareness of the natural world (Youngentob & Hostetler, 2003), and appreciation of the intrinsic values of protected areas (Ham, 2002). A frequently overlooked outcome of interpretation is its ability to foster positive public relations, most frequently between the managing agency providing the interpretation and local communities (Ham, 2002). A salient example of this is the interpretative trail at the Great Smoky Mountains National Park that originates near the Oconaluftee Visitor Center. The trail was initiated as a collaborative effort between the park and the Eastern Band of Cherokee Indians. This interpretive trail provides information to visitors regarding the culture of the Cherokee and has served as a positive campaign effort to link these two factions, which have, in the past, been at odds with each other. More recently, interpretation is seen as a mechanism

for influencing and modifying visitor behavior. Thus, interpretation is regarded as not simply a vehicle to foster awareness and appreciation, but as a management strategy to help meet objectives by influencing attitudes, knowledge, and/or behavior.

Philosophically, this moves interpretation from simply conveying factual information and fostering awareness to an effort that attempts to strategically influence attitudes and behaviors in a predetermined direction (Ham & Krumpe, 1996).

#### *Research on Four Key Visitor Education/Interpretation Strategies*

To assist with dissemination of education messages such as LNT, managers frequently employ one or more of several techniques. In a study of wilderness managers, Douchette & Cole (1993) provide a review of the primary techniques used to disseminate education, classifying these strategies into two categories; media-based and personnel-based educational techniques. Media-based educational techniques include brochures, maps, posters, signs, guidebooks, kiosks, displays, videos, slide shows, radio, computers, and television. Personnel-based educational techniques include interpretation, presentations, trainings, inter-personal communication, etc., in agency offices, visitor centers, at trailheads, campgrounds, in public meetings, and in the backcountry. In a study conducted with US National Park Service managers, Marion, Roggenbuck, and Manning (1993) discovered three out of four National Parks had a minimum-impact educational strategy in place, however only 51% of those parks provided literature to most or all backcountry visitors. In short, there appears to be wide variability in educational dissemination strategies employed by federal land managers to promote minimum-impact education.

Investigations assessing the role of education in protected area contexts are primarily interested in the efficacy of education to influence knowledge, attitudes, and/or behaviors. Marion and Reid (2007) and Manning (2003) both provide summaries of prior studies and review the theories that have underpinned these investigations. It deserves note that a substantial portion of past evaluations have been atheoretical. Manning (2003) has classified these investigations into four categories, the influence of education on; visitor use patterns, knowledge (particular focus on minimizing impacts), visitor attitudes concerning management policies, and depreciative behavior. We have taken a different approach by classifying past efforts to assess educational efficacy into the following four categories; (1) printed media/literature (brochures, signs, kiosks, etc), (2) face-to-face communication with park personnel, (3) audio/visual presentations, and (4) websites.

#### *Printed Media/Literature*

A substantial amount of literature exists examining the influence of printed media/literature on visitors' knowledge, attitudes, and behaviors. In one of the earliest investigations, Lime and Lucas (1977) examined the influence of mailed information on the selection of travel destinations in the boundary waters canoe area. The conclusion was that mailed information, if provided early enough, can assist visitors with trip planning. A second early study examined how trailhead brochures might be used to disperse wilderness campers in a heavily used wilderness area in the southeastern US (Roggenbuck & Berrier, 1982). Results were nonsignificant between the treatment and control group for dispersing visitors. Consistent with the Roggenbuck and Berrier (1982)

study, Passineau, Roggenbuck, and Stubbs (1994) discovered that trailhead posters did not cause significant changes regarding behavioral intentions and behavior of wilderness visitors for adopting minimum-impact practices. In a study of trailside bulletin boards, Cole, Hammond, and McCool (1997) found significant increases in knowledge amongst hikers exposed to a message board. However, the amount of material on the board appeared to be a limiting factor with the researchers concluding that those exposed to more than two messages could not remember any more than those exposed to only two. Additionally, various types of user groups would pay longer attention to message boards; 71% of hikers stopped to review messages while less than one in three horseman users stopped. A more recent study using an experimental design assessed differences in interpretive (educational) and sanction messages on behavioral intentions. Across all four scenarios, interpretive messages were as effective as sanction based messages, and in one case more effective. In all scenarios, messages were more effective than no message at influencing behavior (Duncan & Martin, 2002). In summary, the effects of printed media seem to be minimal on impacting the knowledge and/or behavior and behavioral intentions of those exposed to them and there would appear to be a limiting factor related to sheer amount of information.

#### *Face-to-Face Communication with Park Personnel*

In a study of wilderness managers, face-to-face communication with agency personnel was perceived to be the most effective educational strategy (Douchette & Cole, 1993). Evaluations of visitors in natural areas seem to confirm this finding. A study of hikers at Mt. Rainer National Park found those hikers given an informative talk by

rangers were much less likely to engage in off-trail hiking than those in the control group (Kernan & Drogin, 1995). This echoes the findings of Vander Stoep & Roggenbuck (1996) who indicated personnel contact to be the most effective educational strategy for influencing visitors' behaviors in directions preferred by management.

#### Audio-Visual Presentations

Assessment of the effectiveness of audio-visual presentations for influencing knowledge, attitudes, and behavior in natural area contexts is limited. As part of a larger study, Dowell & McCool (1986) assessed the effectiveness of a slide show on knowledge using a sample of boy scouts. With advances in technology, audio/visual educational dissemination strategies will likely see increased use however a review of the literature failed to illuminate relevant investigations regarding the effectiveness of audio-visual presentations in natural area contexts.

#### Websites

The internet is the newest dissemination tool being utilized by wilderness and other natural area managers as a strategy for influencing knowledge, attitudes, and behaviors of visitors and is a relatively unexplored avenue for research. While not addressing effectiveness, Griffin (2004) explored dissemination of LNT information via NPS websites. This study concluded that over one-third of NPS park specific websites do not mention LNT. Additionally, less than 30% of NPS websites linked to the LNT webpage. Despite the lack of evidence, dissemination of messages via the internet is likely to become more prevalent in the future.

There are several conclusions that can be garnered from the literature review above. We are in agreement with Manning (2003) and Marion and Reid (2007) that visitor education can be effective in addressing knowledge, attitudes, and behavior of visitors to protected areas. This finding supports the utilization of education as a primary management strategy. However, it appears that educational effectiveness varies by strategy. Manning (2003) recommends the use of ‘multiple media’ to disseminate information (p. 25) although research has shown there to be a ‘threshold,’ where information overload, either from a single source, or multiple sources such as signs, personnel, and audio-visual, can lead to a negative experience (Cole, et al., 1997; Roggenbuck, 1992). Thus, promotion of messages should focus on simple messages that are clear and concise (Cole, et al., 1997). Finally, emerging principles for education have been provided by Manning (2003), and include; reaching the visitor during trip planning, targeting underlying beliefs of visitors and the consequences of target behaviors, and when possible providing personal contact between agency personnel and the visitor.

#### *Shortcomings of Environmental Education/Interpretation*

Interpretation as a field has suffered from a number of criticisms. One salient criticism is that the term ‘interpretation’ lacks a unifying definition (Ham, 2002). The most popular definition of interpretation was posited by Tilden (1957) when he described interpretation as “revealing meaning and relationships, through the use of original object, by first hand experience, and by illustrative media, rather than simply to communicate factual information.” Since that time interpretation has ‘come of age’ and in doing so is now recognized as a mechanism for not only fostering ‘awareness’ and ‘appreciation,’

but for changing attitudes, knowledge, and behavior (Ham, 2007a). The problem arises that without a unifying definition, the construction of models and theory and the subsequent evaluation and refinement of those products is difficult at best (Ham, 1997).

Another second shortcoming of interpretation has been the assumption that by increasing knowledge, environmentalism will increase. Interpreters assumed for years that the relationship was linear – however research has proven it is not (Hungerford & Volk, 1990). Tilden eluded to this linkage when he quoted from a National Park Service Manual the phrase “through interpretation, understanding, through understanding, appreciation, through appreciation, protection” (Tilden, 1957, from Ham, 2007b, p. 20). Ham described it as a didactic paradigm: “if they know what we know, they’ll care as we care” (In draft, p. 4; Chapter 2). It has only been within the last 10 years that this assumption has been rejected and that a need to target individuals’ salient belief structure is necessary to effectively change the behavior of interest (Ajzen, 1991; Ham & Krumpal, 1996).

A third criticism is that for the first 30+ years of its existence (Tilden to the early 90s), interpretation efforts all but ignored relevant and applicable theory. The Theory of Reasoned Action was formulated in the mid-1970s (Fishbein & Ajzen, 1975) yet it took nearly 20 years for this basic, yet extremely applicable theory to find utility within the field of interpretation. Fortunately, this theory, as well as other theoretical structures from the psychology and communication fields, has begun to find their way into interpretation.



The field of interpretation has also suffered from what is termed a lack of specificity (Kohl, 2005). Early interpretation efforts aimed to raise awareness and appreciation. Interpreters today still have this goal but also aspire to change cognitive structure, beliefs, attitudes, knowledge, and behaviors of the audiences. Increasing the level of specificity within the field requires asking those charged with interpretation to formulate exact goals and objectives for reaching their intended outcomes. Once goals and objectives are formulated specific and strategic strategies can be implemented to obtain those outcomes.

The final shortcoming that interpretation seems to suffer from is that of unrealistic expectations (Ham, 2007a). Interpreters typically have short amounts of time with audiences, anywhere from seconds to an hour, at most. Additionally the audience is ‘non-captive’ meaning they do not have to ‘pay attention.’ Couple this lack of captivity to a short amount of time and its any wonder interpretation has any effect on changing attitudes, knowledge, or behavior.

#### *Strategies for Enhancing the Effectiveness of Environmental Education/Interpretation*

A number of strategies exist for increasing the effectiveness of interpretation in reaching targeted outcomes. However, it is important that the desired outcome(s) be identified before designing enhancement strategies. This argument is consistent with Ham who emphasized that interpreters need to have a clear conceptualization of ‘the end game’ or the outcomes they wish to see realized (Ham, In draft). Ham continues to elaborate on this point, stating “until we’re clear on what we’re trying to achieve, having a view of ‘excellence’ – seeing how to evaluate it and how to get there – isn’t even

possible” (Ham, In draft, p. 6). As indicated earlier in this literature review, education is likely to have limited effectiveness for curbing actions that are illegal or unavoidable. If however actions are careless, unskilled, and/or uninformed, then education is likely a viable strategy (Manning, 2003).

One of the latest additions to increasing the effectiveness of interpretation is the use of relevant and applicable theoretical frameworks for increasing the efficacy of interpretation efforts. Review and discussion of applicable theoretical frameworks can be found in Chapter Three of this dissertation.

Another mechanism for enhancing the effectiveness of interpretation as a behavior modification strategy is the use of strategic communication/persuasion strategies (Ham, 1997). Persuasive communication “involves the use of verbal messages to influence attitudes and behaviors” (Ajzen, 1992, p. 2). Philosophically this is an interesting argument as it advocates moving interpretation from ‘awareness’ and ‘appreciation’ to targeting and then devising strategies to reach specific outcomes. Achieving this desired end state requires overcoming three challenges; (1) the persuasive communication effort must be novel, (2) it must not be part of the initial belief structure, (3) the argument must be strong and personally relevant to the intended audience (Ajzen, 1992). Fortunately, these challenges can be overcome with creative and theoretically devised messages and delivery strategies. In fact, after the identification of desired outcomes, the second most important consideration for an interpretation program is likely the development of a theme for which to base the persuasive communication effort around (Ham, In draft). In commenting on the importance of a theme, Ham stated,

“development of a theme provides both organizational structure and clarity of understanding. Once the theme of a presentation has been chosen, everything else tends to fall into place” (In draft, pp. 1, Chapter 3).

Another well supported notion for increasing the effectiveness of interpretation is connecting the audience to the item or subject of the interpretive effort (Ham, 1992). The literature refers to this as fostering personal relevance. It has been firmly established within the consumer literature that “high involvement messages have greater personal relevance and consequences or elicit more personal connections than low involvement messages” (Petty, Cacioppo, & Shumann, 1983, p. 136). Under this guidance, interpretation efforts should make every attempt to foster personal relevance.

Interpretation can garner several lessons from the field of EE. Firstly, interpretation efforts can benefit from fostering individuals analytic skills. This would entail providing individuals not just information but enough background information to make them ‘informed’ consumers. Secondly, interpretation needs to focus on the development of an internal locus of control. This would involve empowering individuals to take ownership of what they do (Hungerford & Volk, 1990). Finally, targeting the affective domain is likely to be beneficial (Iozzi, 1989). The literature also suggests that making audiences aware of the consequences of their actions can serve to modify intended behaviors (Duncan & Martin, 2002).

The concept of meaningful learning has direct application for increasing the efficacy of interpretation as a mechanism for influencing behaviors in parks and protected areas. Meaningful learning can be said to have occurred when information is transferred,

understood, and the recipient is able to utilize the information within other situations (Mayer, 2002b). Thus, interpretation should target salient beliefs (via the TpB) and equip the visitor with the knowledge and information they will need to handle various situations within the park. This tactic goes beyond simply providing information to the visitor and instead provides them what they need to analyze, evaluate, and apply what they have learned in new situations. Thus, to promote meaningful learning interpretation efforts need to emphasis transfer of knowledge to new situations.

## Leave No Trace

### *Introduction*

Leave No Trace is the most widely disseminated environmental education message addressing human powered outdoor recreationists in existence. The LNT principles are designed to provide human powered outdoor recreationists with a set of core ‘best practices’ to limit their impact on the natural world with the end goal of instilling an environmental ethic amongst those exposed to them and influencing behavior to support management objectives (Hampton & Cole, 2003; Harmon, 1997). LNT is particularly appealing to federal land managers as it provides a light-handed approach for modifying visitor behavior as oppose to using more heavy-handed approaches such as sanctions and/or enforcement.

### *History & Development of the Leave No Trace Visitor Education Program*

The foundation of the LNT program can be traced back to the 1960s when the US Forest Service began to encourage ‘pack it in – pack it out’ messages to users. These

early messages, aimed to reduce littering in backcountry, are now considered precursors to LNT (Daniels & Marion, 2005). The effort was modeled in part on the success of the anti-forest fire campaign (Smoky Bear). By the mid-70s the effort had evolved to what are now considered early ‘minimum-impact camping’ messages. As recreation use increased through the 1980s, it became evident that a more comprehensive program was necessary to address impacts from recreationists. To help meet the need of educating the recreating public, the USFS teamed with the National Outdoor Leadership School (NOLS) in the early 1990s to develop the LNT message (Marion & Reid, 2001). Through this partnership with NOLS, LNT continued to expand throughout the 1990s (Marion & Reid, 2001), ultimately resulting in the seven LNT principles depicted in Figure A.1. As they stand today (March, 2009), the seven LNT principles are: (1) Plan ahead and prepare, (2) Travel and camp on durable surfaces, (3) Dispose of waste properly, (4) Leave what you find, (5) Minimize campfire impacts, (6) Respect wildlife, and (7) Be considerate of other visitors.

Leave No Trace Principles (www.Int.org)

1. Plan ahead and prepare
2. Camp and travel on durable surfaces
3. Dispose of waste properly
4. Minimize campfire impacts
5. Be considerate of other visitors
6. Leave what you find
7. Respect wildlife

*Figure A.1* Leave No Trace Principles

### *Scientific Foundation of LNT*

The current LNT message is built upon the research of various recreation ecologists that was used to inform the development of a broad conceptual framework made up of seven principles suitable for application in a multitude of environmental settings (Monz, 1994). Indeed, much of the work to develop and refine the LNT principles was based upon work from the field of recreation ecology (Cole, 1989, 1992; Hammitt & Cole, 1998; Hampton & Cole, 2003; Leung & Marion, 2000). These publications, as well as numerous other scientific studies, have provided a solid foundation from which the LNT conceptual framework has been built. However, based in-part on the concept of ecosystem management, the LNT message specifically acknowledges that to be effective, education efforts must address both ecological and sociological impacts caused by human intrusion.

### *Incorporation & Formalized Partnerships*

In 1994, Leave No Trace was incorporated as a 501(c)3 nonprofit organization and named 'The Leave No Trace Center for Outdoor Ethics' (The Center). The mission statement states that The Center is 'dedicated to the responsible enjoyment and active stewardship of the outdoors by all people, worldwide' ([www.lnt.org](http://www.lnt.org)). In 1993, The Center signed a memorandum of understanding with the US Forest Service, Bureau of Land Management, Fish & Wildlife Service, and NPS to promote the LNT message on federal lands. This agreement served to formally adopt the LNT principles as the primary visitor education tool addressing human powered recreationists on federal lands and has positioned LNT as the most pervasive and widely promoted minimum-impact visitor

education program in existence. Other adopters' of the LNT principles have included various state level land management agencies, including the recent adoption by all 50 state park managers representing some 5,000+ state parks, as well as several foreign countries including Ireland and Taiwan ([www.lnt.org](http://www.lnt.org)).

### *Research Investigating Leave No Trace*

There are a large number of studies examining the efficacy of visitor education to influence human behaviors, going back to at least Fazio's (1979) study of camping practices at Rocky Mountain National Park. Investigations addressing the efficacy of LNT are, however, much less frequent within the literature and largely atheoretical, despite the wide use of persuasion and communication theory in education research. This is in spite of the fact that various researchers have called for additional investigations of the program (Cole, 1998; Confer, et al., 1999; Wright, 1999). That said there are several LNT oriented studies applicable to this investigation (Christensen & Cole, 1999; Confer, et al., 1999; Harding, Borrie, & Cole, 1999; Newman, Manning, Bacon, Graefe, & Kyle, 2003; Reuhrwein, 1998; Stubbs, 1991).

A large majority of previous LNT based investigations have examined knowledge of the principles. In an early study, Fazio (1979) examined Rocky Mountain National Park visitors knowledge of low-impact practices utilizing multiple choice tests, concluding that overall knowledge levels amongst respondents was low. Dowell & McCool (1986) assessed Boy Scouts' knowledge of LNT post education program utilizing a 7-question scale. Results from this study indicated that treatment group knowledge increased both immediately after treatment and one-month post treatment.

Stubbs (1991) investigated objective knowledge of low-impact practices (quiz) and the effectiveness of visitor education at lessening instances of visitor induced recreational impacts in the Shining Rock Wilderness. Knowledge was found to be low, a result he surmised caused by changing agency recommendations regarding practices.

Additionally, while a positive correlation was discovered between knowledge of proper campsite attributes and selection of actual campsites, the study was hindered by a small number of observations. He concluded posters addressing three practices; campsite selection, tent placement, and use of stoves, raised knowledge levels, increased behavioral knowledge in the desired direction, and improved behavior (observed).

Recent contributions has included work by Newman, Manning, Bacon, Graefe, and Kyle (2003) who evaluated Appalachian Trail hikers knowledge of minimum-impact (aka LNT) skills. These authors concluded that; “standardized measures of minimum-impact knowledge and skills based on these principles (LNT) should be developed and periodically incorporated into surveys of visitors to parks, wilderness, and related areas.” Additionally, “better understanding of visitors knowledge and associated behavior will allow managers to shape and implement information dissemination programs that are more likely to be effective in protecting park and wilderness resources and the quality of visitor experiences” (Newman, et al., 2003, p. 33 & 34).

As noted earlier, many previous investigations were atheoretical. However, a report compiled by Miller, Borrie, and Harding (2001) provided a theoretical review of factors that may influence the practice of minimum-impact (i.e. LNT) behaviors. While not directly testing any of the theories reviewed, this research served to direct our



theoretical orientation for the present investigation. Reuhrwein (1998) assessed knowledge and self-reported behavior of backcountry recreationists in southern Utah's redrock country through the lens of the Theory of Reasoned Action (Fishbein & Ajzen, 1975). However, Reuhrwein's study used single item measures of attitudes, which was the likely culprit for the weak to nonexistent (significant) correlations between primary study constructs. Thus, to the best of our knowledge, this is the first research to explicitly test a theoretical framework with a high level of statistics analysis with the goal of further understanding the drivers of compliance with LNT principles.

As evident above, a large majority of past LNT oriented studies have utilized knowledge as the outcome variable (Dowell & McCool, 1986; Fazio, 1979; Reuhrwein, 1998; Stubbs, 1991). There are two primary concerns with knowledge based assessment tools. Firstly, such tools utilize a dichotomous answer format (correct or incorrect) and thus solicit minimal amounts of variability. The second concern is the recognition that human behavior is likely determined more by attitudes (Ajzen, 1991; Eagly & Chaiken, 1993) than knowledge, particularly in environmental contexts (Kaiser, et al., 1999; Pooley & O'Connor, 2000; Weigel & Weigel, 1978). Other research substantiates the need to move away from knowledge based assessment tools to attitudinal or belief based measures. Consider findings from Stubbs (1991), who concluded that even though recreationists might know the 'correct' answer regarding backcountry practices, their behavior may not consistently reflect knowledge. Newman et. al., concluded "standardized measures of minimum-impact knowledge and skills based on these principles (LNT) should be developed" and that "better understanding of visitors

knowledge and associated behavior will allow managers to shape and implement information dissemination programs that are more likely to be effective in protecting park and wilderness resources and the quality of visitor experiences” (2003, p. 33 & 34).

While we are in agreement that a standardized measure is necessary and currently lacking, we contend that the measure should not address knowledge of behavioral practices but rather attitudes regarding the behaviors in question. Thus, this current effort is designed to fill this recognized need in the literature.

In short, a comprehensive review of the literature indicated that despite widespread calls (Cole, 1998; Confer, et al., 1999; Wright, 2000), no systematic evaluation of the LNT program has been conducted and the understanding of the determinants of compliance is still minimal (Marion & Reid, 2001; Miller, et al., 2001; Roggenbuck, 1992) .

## APPENDIX B

### THEORETICAL FRAMEWORKS

#### Background & Introduction to the Chapter

This dissertation investigated the Leave No Trace (LNT) backcountry visitor education program in two National Park Service (NPS) Units: Glacier National Park (GNP) in northwest Montana and Olympic National Park (ONP) in northwest Washington. Currently, LNT is the most pervasive outdoor skills and ethics training program addressing human powered recreationists in existence. The program is particularly appealing to land managers as it represents a ‘light-handed’ approach for protecting natural resources and is considered more in line with the spirit of the Wilderness Act. The program was formally adopted by the NPS in 1993 as the primary visitor ethics training program and although LNT has been promoted at varying levels and through various means Servicewide, empirical investigations into the effectiveness and diffusion of the program have been scant to nonexistent. Thus, the purpose of this dissertation was to examine overnight NPS backcountry visitors’ behavioral intentions to comply with widely promoted LNT principles as well as their opinions regarding the efficacy of various LNT education delivery strategies.

To help meet this end, this appendix is presented as two sections, each providing discussion of the two theoretical frameworks that guided operationalization of study variables. The investigation utilized the Theory of Planned Behavior (Ajzen, 1991) and Rogers Diffusion of Innovations Theory (Rogers, 2003) as well as the LNT principles for

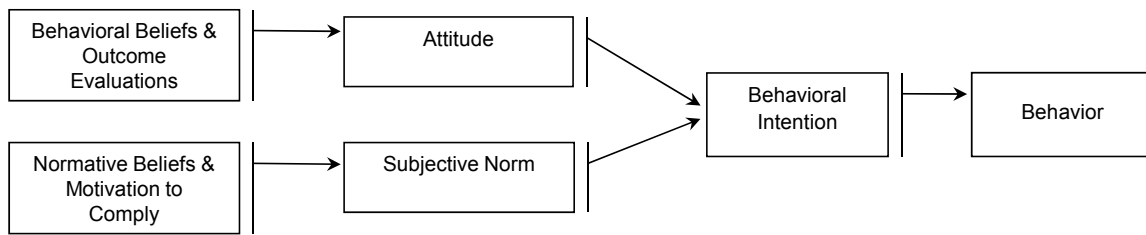
ethical and responsible outdoor recreation as a conceptual framework. Taken together, these theories and framework helped to guide key aspects of the investigation including defining constructs, item generation and refinement, and later as a priori dimensions tested via confirmatory factor analysis procedures. The first section describes the Theory of Planned Behavior, a general theory of social psychology used to explain human behavior. The second section of this appendix describes Diffusion of Innovation Theory, a general theory of communication addressing how ideas become diffused into society and the rate at which they do so.

So why theory? Theory can be defined as “the construction of explicit explanations in accounting for empirical findings” (Bengtson, et al., 1997, p. 572). The utilization of theory can provide guidance for understanding phenomenon of interest by providing insight into the correct types and forms of questions and guide variable selection and operationalization of study constructs. Additionally, the application of an appropriate theory leads to asking the correct types and forms of questions (Henderson, et al., 2004). It is also recognized that “there is no single theoretical approach that can be applied in all situations, and no one can predict with certainty what its outcome will be” (Carter, 2001, p. 8, from Johnson & Vande Kamp, 1996). In the absence of relevant theory, a conceptual framework can be utilized to inform decision-making processes.

## Explaining Human Behavior: Reasoned Action & Planned Behavior

### *Theory of Reasoned Action*

The Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) are general theories of social psychology that seek to explain human behavior (Fishbein & Ajzen, 1975). Both frameworks “rest on the assumption that humans are reasoning animals who systematically utilize or process the information available to them” (Fishbein & Manfredo, 1992, p. 30). The central premise of both theories is that people make rational decisions and that the most accurate predictor of behavior becomes one's intention to engage in said behavior. Specifically Fishbein and Ajzen stated “a behavioral intention measure will predict the performance of any voluntary act, unless the intention measure does not correspond to the behavioral criterion in terms of action, target, context, time-frame and/or specificity” (as cited by Sheppard, et al., 1988, p. 325, from Fishbein & Ajzen, 1975). Intention they hypothesized is a function of attitude toward that behavior (positive or negative) and subjective norms (what others feel about this behavior) (Ajzen & Fishbein, 1980). The theory contends that humans are rational and have the ability to choose or determine their actions (volitional control). The central premise of TRA is this: behavior can be examined through understanding behavioral intention, which is determined by: 1) an individual's attitude and 2) perceived social pressure to perform the behavior. Figure B.1 depicts the TRA:



*Figure B.1* Theory of Reasoned Action (Fishbein & Ajzen, 1975)

The theories are based upon attitudes, the study of which can be traced back as far back as the mid-1800s. Herbert Spencer is generally credited with being the first psychologist to utilize the term attitude when he did so 1862 (Fishbein & Ajzen, 1975). His argument was that an individual's decision to behave or act in a certain way was directly attributable to their attitude toward that behavior (Ajzen & Fishbein, 1980). The term attitude is commonly defined as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (Eagly & Chaiken, 1993, p. 1). As the field of psychology continued to grow and evolve, various measures were developed to examine the construct of ‘attitudes.’ While original research viewed attitudes as one-dimensional, the field quickly evolved to recognize that attitudes were in fact multidimensional and comprised of affect, cognition, and conation (Fishbein & Ajzen, 1975). Research into attitudes continued to evolve and progress, however it had become apparent to psychologists that empirical evidence supporting the relationship between behavior and attitudes was weak. In response to this recognized weakness Fishbein and Ajzen began developing a theory that could accurately predict and be utilized to understand human behavior. As a first step in reaching this goal, they felt it essential to identify and measure the behavior of interest. Once the behavior was

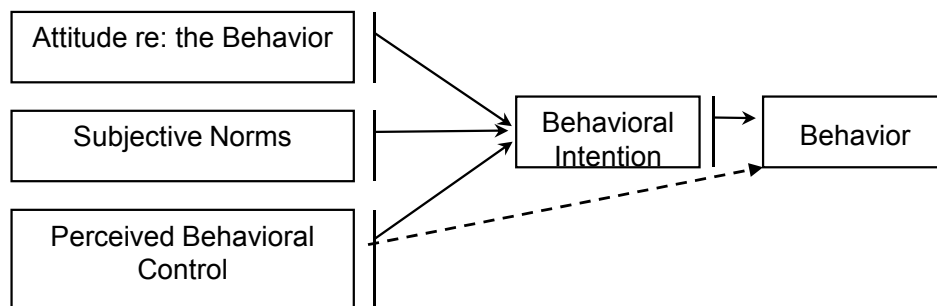
identified and defined the researcher could then identify determinants of said behavior (Ajzen & Fishbein, 1980).

As evident in Figure B.1 above, attitudes are formed by both behavioral beliefs and the outcome expectations or evaluations. Beliefs are both a vital and essential component of attitude theories, as they are the foundation from which attitudes are constructed. Beliefs are a rather vague concept and are represented through how someone feels about a certain product or service, or in the case of LNT compliant behavior, an environment (Fishbein & Ajzen, 1975). Beliefs can be created or manifested through direct experience or observation or from outside sources including other people or media sources. Individuals form beliefs about themselves, other people, products, behaviors, and institutions among others (Fishbein & Ajzen, 1975). It is also recognized that only a few beliefs, referred to as salient beliefs, actually influence attitude (Ajzen & Fishbein, 1980).

Subjective norms refer to the perceived pressure and individual might feel to perform a certain behavior from those around you (normative beliefs/peer approval) and the motivation you feel to comply with these wishes of these individuals. Normative beliefs are hypothesized to contain two components; injunctive norms and descriptive norms. Injunctive norms become a function of other individuals (who are important to you) approval or disapproval of said behavior. Operationalization of injunctive norms attempts to tease apart the social norm component of the model. Descriptive norms examines perceptions of the behavior or attitudes of other individuals.

*Theory of Planned Behavior*

The Theory of Planned Behavior (TPB) was developed as an extension to TRA by Ajzen to account for behaviors which are not completely under the control of the volitional control of the individual (Ajzen, 1991). The central premise of the TPB is that accurate measurement of attitudes, subjective norms, and perceived behavioral control can provide an accurate prediction of behavioral intentions and therefore behavior. Specifically the TPB is a theory “designed to predict and explain human behavior in specific contexts” (Ajzen, 1991, p. 181). It is because of this specific function that the TPB is so well suited for application within this proposed research. Figure B.2 depicts the TPB (Ajzen, 1991):



*Figure B.2 Theory of Planned Behavior (Ajzen, 1991)*

As described earlier, the TPB is based upon the same premise and determinants of behavioral intention as the TRA with the addition of what Ajzen terms perceived behavioral control. It is important to recognize that perceived behavioral control is different from locus of control. Where locus of control is typically stable across activities and context, perceived behavioral control may vary widely depending upon the activity or context within which that activity takes place (Ajzen, 1991). Ajzen further describes



perceived behavioral control as aligning closely with Bandura's concept of self-efficacy (1977), which "is concerned with judgments of how well one can execute courses of action required to deal with prospective situations" (Ajzen, 1991 from Bandura, 1982, p. 122). In its most simple form, self-efficacy deals with the confidence of an individual in accomplishing a task.

Recent contributions to the TPB now theorize the perceived behavioral control component as being multidimensional and comprised of two distinct dimensions: perceived control and perceived difficulty (Traifmow, et al., 2002). Ajzen (2002) defined PBC as "the perceived ease or difficulty of performing the behavior" (p. 665), from which one could infer that the construct is composed of two parts: perceived control over performance of a behavior as well as perceived difficulty with carrying out a behavior of interest. Traifmow et. al., define perceived control as "the extent to which people consider the performance of a behavior to be under their voluntary control" and perceived difficulty to be "whether people consider a behavior to be easy or difficult to perform" (2002, p. 101).

Despite this differentiation, a review of the literature illuminated wide variation in operationalization of the PBC construct. For instance, a number of past efforts employing TPB used either a unidimensional approach to capturing this construct or completely ignored the perceived difficulty component (Armitage & Conner, 1999a). However, Terry & O'Leary (1995) using a SEM approach, discovered perceived control and perceived difficulty provided a better fit when modeled independently rather than unidimensionally (see also Ajzen, 2002; Traifmow, et al., 2002). Not all researches have

agreed with this finding however. Chan and Cheng (1998) put forth that perceived difficulty is better represented as part of the attitudinal construct of TPB. Kraft, Rise, Sutton, & Roysamb (2005) corroborated Chan and Cheng and report that perceived difficulty items ‘overlapped substantially with affective attitude’ (pg. 479) and that the inclusion of the perceived difficulty construct causes the PBC (control) construct to be overestimated and the attitudinal construct to be underestimated. In conclusion, the PBC construct remains a point of uncertainty with TPB research (Ajzen, 2002).

The underlying value of the TRA/TPB to wilderness management lays in the linearity the theory hypothesizes to exist between the determinants and outcome (behavior or behavioral intention). If attitudes can be an accurate predictor of intentions, intentions guide behavior, and attitudes can be changed, then wilderness managers can manipulate visitors’ behaviors in a way they deemed acceptable by changing the salient attitude or belief structure.

The TPB has been routinely employed for research efforts exploring leisure/recreation behavior (Ajzen & Driver, 1991, 1992; Hrubes, et al., 2001), conservation/pro-environmental behavior (Clark & Finley, 2007; Kaiser, et al., 2005; Lam, 2006; Oreg & Katz-Gerro, 2006) as well as natural resource management issues (Kaiser & Scheuthle, 2003; Nesbitt, 2006; Pouta & Rekola, 2001; Vogt, et al., 2005). Finally the TPB is recognized as a robust theory suitable for application of the efficacy of visitor education in natural areas (Marion & Reid, 2007).

## Understanding Idea Dissemination: Diffusion of Innovations

How do innovations, those ideas, practices, or objects that are new, become adopted into society? What causes one idea to rapidly become infused while others do not? Innovations succeed or fail for any number of reasons; Diffusion of Innovations Theory (DT) seeks to explain why an idea becomes adopted into society by exploring the variables that help account for adoption (Rogers, 2003). By better understanding the factors that influence adoption, more efficient strategies for introducing and diffusing innovations into society can be developed.

Defined diffusion is “the process in which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 2003, p. 5). Underlying the theory is that new ideas are not immediately adopted into society, they take time and may succeed or fail for any number of reasons; DIT critically examines the antecedents of the innovation. Everett M. Rogers was the preeminent researcher exploring how ideas become diffused into society. His work *Diffusion of Innovations* (2003) is currently in its 5<sup>th</sup> edition and presents a comprehensive overview of the conceptual foundation of the theory as well as empirical evidence for support. The seminal piece on diffusion was written in 1943 and examined the adoption of hybrid corn seed by a number of farmers in Iowa.

### *4 Main Elements of Diffusion*

Diffusion is recognized to be a process of four things- 1) innovation is 2) communicated through channels, 3) over time, and 4) among social systems (Rogers, 2003, p. 11). The following is a description of each section of diffusion.

### *1) Innovation*

An innovation refers to “an idea, practice, or object that is perceived as new” (Rogers, 2003). Even if it has been around for a while, if it is new to the individual it is an innovation. Questions commonly asked by researchers regarding innovation diffusion include; what are the differences between early and late adopters, how do perceived attributes of an innovation effect rate of adoption, and at what point in time does the ‘S’ curve jump (Rogers, 2003, p. 12)?

### *2) Communication through Certain Channels*

Diffusion is a type of communication focused on the sharing of a new idea(s). Rogers provides discourse on a simple model of communication: the innovation, an individual who has knowledge of the innovation, an individual who does not have knowledge of the innovation, and a communication pathway between the two individuals (Rogers, 2003). Various communication channels exist from which the innovation can be communicated, including; mass media and interpersonal channels.

Of particular importance is the subjectivity often applied when discussing diffusion of an innovation. Rogers summarizes that most individuals do not rely on scientific studies to determine if they will adopt an innovation, instead most individuals rely on subjective evaluations that are taken from other people like themselves who have already adopted the idea. Rogers therefore indicates that modeling and imitation is key to an innovation being adopted and that diffusion is a very social process (Rogers, 2003).

Rogers discusses the notion of homophily and heterophily. Homophily, in a discussion of diffusion, deals with the fact most of us associate with others who are similar to ourselves. Diffusion is a social phenomenon. The issue is that those who we associate with and who we are quite similar to (homophily), we often have very little to learn from. They (or we) are not ‘change agents.’ For diffusion to take place, Rogers argues that heterophily, or being surrounded by an individual(s) who has more experience/technical competence. The problem, at a general level, is that two individuals who have differing levels of understanding of a subject may not be able to communicate between each other—they ‘don’t speak the same language.’

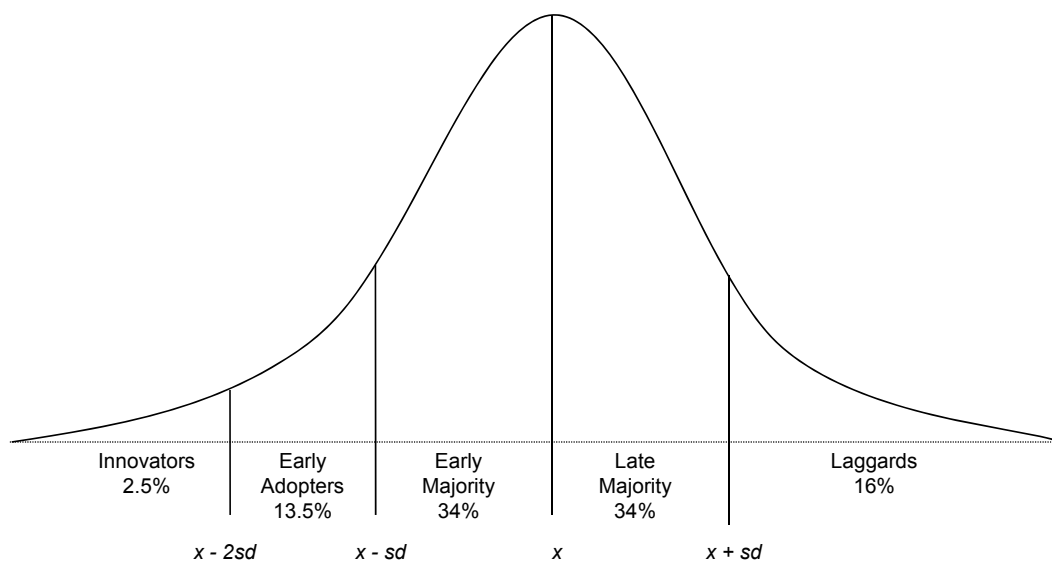
### 3) *Time (process of)*

Time is a critical element of the diffusion theory. Most behavior research is rather timeless- Rogers argues that other behavior research ignores or does not matter. He continues by arguing that the inclusion of time is strength but that measurement of time via respondents memory recall is a weakness (methodologically). Time is involved in diffusion at three distinct points (Rogers, 2003):

The first stage is referred to the Innovation-decision (I-D) process, the period of time from when an individual learns about an innovation to when they accept/reject it. During this stage Rogers posits there are five stages of the process; *knowledge* – when an individual learns of an innovation, *persuasion* – when an individual forms a favorable/unfavorable attitude regarding the

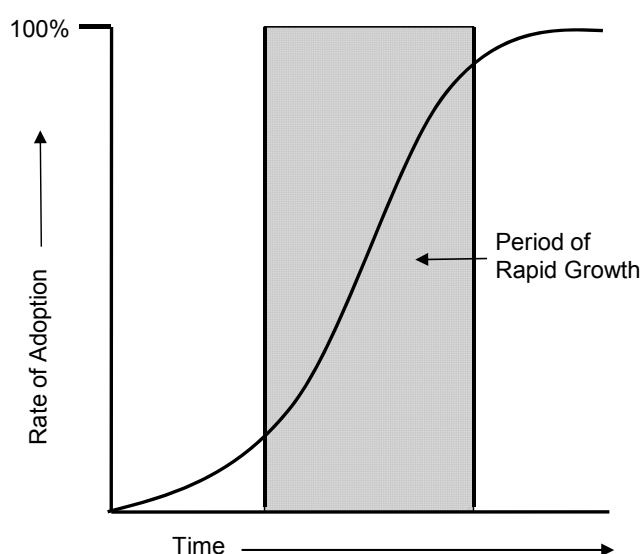
innovation, *decision* – individual undertakes actions that lead to adopting or rejecting the innovation, *implementation* – individual puts the innovation into practice, and *confirmation* – individual seeks reinforcement about innovation. This process is highlighted by the individual seeking additional information regarding the process. It is an opportunity to lessen the uncertainty of the proposed adoption.

The second place where time is a component of Diffusion Theory is termed Adopter Categories. At this point the individual has made their decision and can be compared to others around them. The categorical titles are as follows; innovators, early adopters, early majority, late majority, and laggards. The distribution follows a normal bell shaped curve and distribution. See Figure X below.



*Figure B.3* Adopter Categorization on the Basis of Innovativeness (Rogers, 2003, pg. 281)

The rate of adoption of an innovation is also measured via time. Rate of adoption deals with how quickly the innovation becomes adopted into the social system and is typically plotted via an ‘S’ shaped curve. Various research strategies have examined why some innovations have a steep curve and other more slowly.



*Figure B.4* Adoption of an Innovation Over Time (Rogers, 2003, pg. 344)

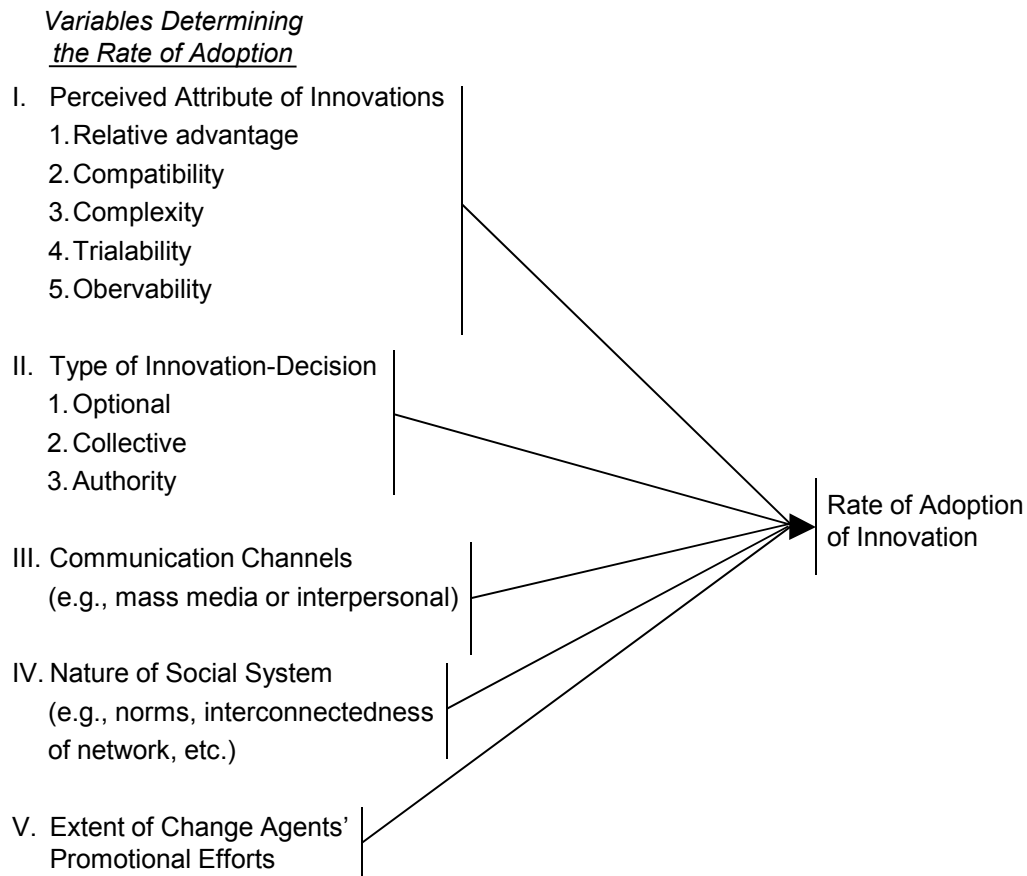
#### *4) Communication within a Social System*

The fourth main element of diffusion deals with how the innovation is spread throughout a social system. Rogers defines a social system as “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (2003, p. 37). Rogers provides discussion of how a social system has a structure that allows for regularity & stability for individuals behavior

within the system. Norms are also a recognized and integral part of social systems. The system itself may consist of “all consumers in the US” or all “peasants in a village” (2003). One of the most important individuals during this process are termed ‘opinion leadership.’ These individuals are members of a social unit who influence others, and become “the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency (Rogers, 2003, p. 27). The other important individual during this period is termed the ‘change agent.’ Change agents are professional individuals who “influences the innovation-decision in a direction deemed desirable by a change agency” (Rogers, 2003, p. 27).

Innovations can either be accepted or rejected at the individual level or at the social system level. At the individual level, adoption or rejection of an innovation may be influenced by norms of the group or through interpersonal communication. At the social system level adoption or rejection could be via one of two avenues. The innovation could be adopted or rejected by consensus among members of the system. Conversely the innovation could be adopted or reject made by a few people in the system who have authority, technical experience, power, status, etc. Figure B.5 depicts the variables posited to determine the rate of which an innovation is adopted.





*Figure B.5 Variables Determining the Rate of Adoption of Innovations (Rogers, 2003, pg. 222)*

#### *Application of DOI Theory to Natural Resource Management & Environmental Behavior*

Diffusion of Innovations Theory is well supported by the scientific literature as evidenced by the popularity of the theory. To date some 5,200 publications have used diffusion theory with approximately 120 new studies per year utilizing the theory (Rogers, 2003). Somewhat surprisingly, application of DIT within the natural resource management field has remained scant. The one piece identified after a long literature search was written by Vita Wright, scientist with the Aldo Leopold Wilderness Research

Institute, and was largely conceptual (2004). In it, she provides an overview of the theory for individuals and land managers not yet familiar with the theory. The theory is unique in that it potentially will allow a closing of the gap between researchers and the scientific community.

APPENDIX C

SUPPORTING INFORMATION

GLACIER NATIONAL PARK AGREEMENT TO CONDUCT  
RESEARCH APPROVAL LETTER



IN REPLY REFER TO:

L30

June 6, 2007

United States Department of the Interior

NATIONAL PARK SERVICE

Glacier National Park  
West Glacier, Montana 59936  
(406) 888-5441  
FAX: (406) 888-5581

Mr. Wade Vagias  
263 Clemson Hall  
Clemson University  
Clemson, SC 29634

Dear Mr. Vagias:

Please find enclosed two copies of your approved 2007 research permit number GLAC-2007-SCI-0056 to examine backcountry visitor compliance with recommended leave no trace practices in Glacier National Park. Please sign both copies and return one to me in the enclosed envelope.

Please contact Wilderness Management Supervisor, Fred Vanhorn (406-888-7822) for permission to coordinate with his staff members to distribute contact forms to backcountry visitors. If you would like to request a vehicle pass to enter the park, please contact Christie Schlund at 406-888-7820 or [christie\\_schlund@nps.gov](mailto:christie_schlund@nps.gov) prior to your arrival. To process the request, she will need names of field crew members, a description of the vehicle and the license number along with your arrival and departure dates. Please bring a copy of this letter with you when you pick up your gate pass to show your authorization to receive a pass.

Please review the attached list of General Conditions carefully. Failure to comply with any of the conditions (including failure to submit an Investigator's Annual Report) could result in a revocation of your permit. If you have any further questions or have trouble reaching the above contacts, you may contact me at 406-888-7919 or [tara\\_carolin@nps.gov](mailto:tara_carolin@nps.gov).

Sincerely,

Tara Carolin  
Research Permit Coordinator  
Enclosures

OLYMPIC NATIONAL PARK AGREEMENT TO CONDUCT  
RESEARCH APPROVAL LETTER



IN REPLY REFER TO:

**United States Department of the Interior**  
**NATIONAL PARK SERVICE**

Olympic National Park  
600 East Park Avenue  
Port Angeles, Washington 98362-6798

N2215(OLYM-NRM)

July 10, 2007

Wade Vagias  
263 Lehotsky Hall  
Clemson University  
Clemson, SC 29634

Dear Wade,

We are pleased to notify you that your permit to study Leave No Trace practices within Olympic National Park is approved for calendar year 2007. Please review your permit and sign on the principal investigator's signature line. If others who will work with you on this project are not already noted, please write their names in the appropriate space on the permit. Return the signed permit to us via mail or fax to 360-565-3070. *You need only return the page with your signature!*

Olympic National Park  
Attn: Research Permit Desk  
600 East Park Avenue  
Port Angeles, WA 98362

Keep a copy of your signed permit, as it will serve as a waiver of park entrance, parking and wilderness permit fees during the period of your permit. Please keep a copy of the signed permit with you at all times while conducting research in the park and display it when park fees are being charged.

In order to maintain a good working relationship with our personnel in the field, it is vital that you contact the rangers in the areas where you will be working. Please read the attached page with permit conditions, it lists details of your permit and specific data needs we will ask of you.

Again, we look forward to continuing our work with you and to learn of the results of your study. Thank you for your cooperation. If you have any questions, please feel free to contact your liaison (named on the enclosed Conditions Letter) or park research coordinator, Dr. Jerry Freilich at (360) 565-3082.

Sincerely,

Cat Hawkins Hoffman, Chief  
Natural Resources Division

Enclosures: (2): Permit, Conditions Letter

## COVER LETTER – 1<sup>ST</sup> MAILING

Summer 2007

Dear Olympic National Park Backcountry Visitor:

Thank you for your willingness to participate in this important study. Many individuals enjoy backcountry experiences within Olympic National Park, and we would like for these to remain high quality. For this reason, the National Park Service and researchers from Clemson University are interested in finding out more about your recent overnight backcountry trip.

The enclosed questionnaire is only being distributed to a select number of backcountry visitors, so your participation is essential. All responses are confidential and the information collected will only be reported in aggregate form to assist us in better managing the backcountry resources of Olympic National Park. The questionnaire should take approximately 15 minutes to complete. When you are finished, please place the questionnaire in the enclosed postage-paid envelope and drop in any mailbox. After we receive your questionnaire we will remove your name from our list.

*While this survey is voluntary, your response is very important to the National Park Service. We ask you to complete the enclosed survey independently. If you have any further questions about this study or need a replacement, please call Wade Vagias at (724) 355-0985, email: [wadev@clemson.edu](mailto:wadev@clemson.edu) or Dr. Bob Powell at (864) 656-0787, email: [rbp@clemson.edu](mailto:rbp@clemson.edu). Both can also be reached at:*

Department of Parks, Recreation and Tourism Management  
263 Lehotsky Hall  
Clemson University, Clemson, SC 29634

Thank you in advance for your participation.

Sincerely,

Rick Potts  
Chief – Wilderness Stewardship and Recreation Management Division  
National Park Service  
Washington DC



## QUESTIONNAIRE



National Park Service  
U.S. Department of the Interior

### Olympic National Park Backcountry Visitor Study



© Jerry Freilich 2007

**Summer 2007**

Department of Parks, Recreation, & Tourism Management  
Clemson University  
Clemson, South Carolina 29634

OMB Approval #1024-0224  
NPS #07-038  
Expiration Date 01/31/2008

This questionnaire deals with your attitude and opinions regarding backcountry travel within Olympic National Park. There are no "correct" or "incorrect" answers in this questionnaire so please feel free to express your candid views and opinions. Your answers **will be compiled with other backcountry visitors and will only be reported in broad statistical terms** to help us better manage the Olympic National Park Backcountry. This survey should take approximately 15 minutes to complete.

**Section A: Your Recent Trip**

We would like to know about the specifics of your recent overnight backcountry trip within Olympic National Park. We are referring to the trip you took after being contacted for participation in this study.

1. Did you camp overnight in the backcountry of Olympic National Park during the summer of 2007?  
(please check one answer)  
☐ Yes  
☐ No (if NO, please skip to Section G: Background Information)
2. The backcountry permit from Olympic National Park was registered: (please check one answer)  
☐ Under my name (I was the registered trip leader)  
☐ Under another person's name
3. How many individuals, including yourself, were on your recent backcountry trip to Olympic National Park? \_\_\_\_\_
4. Approximately how many total miles did you travel in the backcountry during your trip to Olympic National Park? \_\_\_\_\_
5. What type of backcountry campsites did you use? (check all that apply & fill in a number)  
☐ National Park Service designated site/area → how many nights? \_\_\_\_\_  
☐ Undeveloped / Primitive area → how many nights? \_\_\_\_\_
6. Which of the following best describes the type of group you were with? (please check one answer)  
☐ Alone – by myself  
☐ Family/Friends  
☐ Organized group (scouts, summer camp, college group, etc.)  
☐ Commercial Group (i.e. you paid for guide services)  
☐ Other (please describe) \_\_\_\_\_
7. What was your primary mode of transportation while in the backcountry of Olympic National Park?  
(please check one answer)  
☐ Foot (hiking)  
☐ Boat (kayak, raft, canoe, etc.)  
☐ Stock (horses, mules, llamas, etc.)  
☐ Other (please describe) \_\_\_\_\_



8. Think back to your recent backcountry trip in Olympic National Park and select the response that most closely corresponds to your behavior. This is very important for the National Park Service! We have provided space for comments if you would like to clarify what you did or explain why you did it. Again, your candid and honest answers are essential to the success of this survey.

**Response Categories**

1 – Never

2 – Almost never, in less than 10% of the chances when I could have

3 – Occasionally, in about 30% of the chances when I could have

4 – Sometimes, in about 50% of the chances when I could have

5 – Frequently, in about 70% of the chances when I could have

6 – Almost every time, in about 90% of the chances I could have

7 – Every time

NA – Not applicable/Does not Apply

*(please circle one number per statement)*

	Never	Almost Never (<10%)	Occasionally (30%)	Sometimes (50%)	Frequently (70%)	Almost Every Time (90%)	Every Time (100%)	Not Applicable
I placed my tent on bare soil, rock, gravel, or sand.	1	2	3	4	5	6	7	NA
I walked around muddy spots on the trail.	1	2	3	4	5	6	7	NA
I discarded biodegradable waste (like apple cores) in the backcountry.	1	2	3	4	5	6	7	NA
I picked up a 'souvenir' (rock, feather, etc.) so I could have something to remember the trip by.	1	2	3	4	5	6	7	NA
I had a campfire.	1	2	3	4	5	6	7	NA
Before setting up my camp, I placed food in agency provided containers or hung it in the air.	1	2	3	4	5	6	7	NA
I cut corners on trail switchbacks.	1	2	3	4	5	6	7	NA
When traveling off trail, the group hiked single file.	1	2	3	4	5	6	7	NA
Charred wood was left contained in the fire ring.	1	2	3	4	5	6	7	NA
Camp was set-up in an open area like a meadow.	1	2	3	4	5	6	7	NA
I walked off the trail to avoid wet or muddy spots.	1	2	3	4	5	6	7	NA
I buried my toilet paper.	1	2	3	4	5	6	7	NA
I kept something I found in the backcountry.	1	2	3	4	5	6	7	NA
I disposed of leftovers away from my campsite.	1	2	3	4	5	6	7	NA
I packed out my toilet paper if a toilet facility was not available.	1	2	3	4	5	6	7	NA

*Comments:*

**Response Categories**

- 1 – Never  
 2 – Almost never, in less than 10% of the chances when I could have  
 3 – Occasionally, in about 30% of the chances when I could have  
 4 – Sometimes, in about 50% of the chances when I could have  
 5 – Frequently, in about 70% of the chances when I could have  
 6 – Almost every time, in about 90% of the chances I could have  
 7 – Every time  
 NA – Not applicable/Does not Apply

(please circle one number per statement)

	Never	Almost Never (<10%)	Occasionally (30%)	Sometimes (50%)	Frequently (70%)	Almost Every Time (90%)	Every Time (100%)	Not Applicable
I burned paper trash in the campfire.	1	2	3	4	5	6	7	NA
If a rock fire ring was not present, I built one to contain a campfire.	1	2	3	4	5	6	7	NA
I fed small wildlife food scraps while in the backcountry.	1	2	3	4	5	6	7	NA
When hiking, I took breaks out of sight of the main trail.	1	2	3	4	5	6	7	NA
I moved small rocks and/or logs around to make my camp more comfortable.	1	2	3	4	5	6	7	NA
I deposited human waste on top of the ground, in an 'out of the way' spot.	1	2	3	4	5	6	7	NA
I approached wildlife so I could get a good view and/or take a picture.	1	2	3	4	5	6	7	NA
If an agency toilet facility was not available, I dug a small hole to deposit my human waste in.	1	2	3	4	5	6	7	NA
I used soap in streams/lakes.	1	2	3	4	5	6	7	NA
While in camp, I ate meals in the designated food prep area.	1	2	3	4	5	6	7	NA
I urinated on vegetation.	1	2	3	4	5	6	7	NA
Before leaving camp I completed a final sweep of my campsite to make sure all trash was picked up.	1	2	3	4	5	6	7	NA
I packed out other campers trash I found in the backcountry	1	2	3	4	5	6	7	NA
I strained dishwater through a filter/screen before disposing of it.	1	2	3	4	5	6	7	NA

Comments:

This section asks questions concerning your past experience in Olympic National Park and other wilderness/backcountry areas and your attachment to such places.

9. Was this your first overnight trip in the backcountry of Olympic National Park?

\_\_\_ Yes (if YES, please skip to Question #10)

\_\_\_ No

→ How many previous overnight backcountry trips have you made to Olympic NP? \_\_\_\_\_

→ What year did you first overnight camp in the backcountry of Olympic NP? \_\_\_\_\_

→ In an average year, how many overnight backcountry trips do you take at Olympic NP? \_\_\_\_\_

10. About how many different wilderness/backcountry areas have you camped in? \_\_\_\_\_

11. In what year (for example 1998) did you first overnight camp in a wilderness/backcountry area? \_\_\_\_\_

12. On average, how many overnight wilderness/backcountry trips do you take in a year? \_\_\_\_\_

13. Regarding the skills necessary for backcountry travel, I consider myself a: *(please circle one number)*:

1                      2                      3                      4                      5  
Novice              Beginner              Intermediate              Advanced              Expert

14. Please indicate your level of agreement with each of the statements listed below using the scale '1' Strongly Disagree to '5' Strongly Agree.

<i>(please circle one number per statement)</i>	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Olympic National Park means a lot to me.	1	2	3	4	5
I enjoy backcountry travel in Olympic National Park more than in any other park.	1	2	3	4	5
I am very attached to Olympic National Park.	1	2	3	4	5
I feel no commitment to Olympic National Park.	1	2	3	4	5
I identify strongly with Olympic National Park.	1	2	3	4	5
I get more satisfaction out of visiting Olympic National Park than from visiting any other wilderness or backcountry area.	1	2	3	4	5
Backcountry travel in Olympic National Park is more important than backcountry travel in any other place.	1	2	3	4	5
I wouldn't substitute any other backcountry/wilderness for the type of backcountry travel I do in Olympic National Park.	1	2	3	4	5

## Section C: Backcountry Influences

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This section is to determine your general opinions concerning backcountry travel in Olympic and your interactions with members of your group.

15. Please rate your level of agreement with the following statements using the scale '1' Strongly Disagree to '7' Strongly Agree.

	Strongly Disagree			Neutral			Strongly Agree
	↓			↓			↓
<i>(please circle one number per statement)</i>							
The people who travel with me on backcountry trips think it is important to camp close to bodies of water.	1	2	3	4	5	6	7
Early in life I spent time hunting.	1	2	3	4	5	6	7
I intended to follow minimum-impact practices during my backcountry trip in Olympic National Park.	1	2	3	4	5	6	7
The other members of my group believe I should not keep any items I may find in the backcountry.	1	2	3	4	5	6	7
In general, the opinions of others has little effect on what I choose to do in the backcountry.	1	2	3	4	5	6	7
Early in life I spent time in the outdoors enjoying nature.	1	2	3	4	5	6	7
I made every effort to follow Olympic National Park recommended minimum-impact practices.	1	2	3	4	5	6	7
The opinions of other members of my group have no effect on where I choose to camp in the backcountry.	1	2	3	4	5	6	7
Other members of my group think it is important to have a campfire during our backcountry trips.	1	2	3	4	5	6	7
Other members of my group believe all litter and trash should be carried out.	1	2	3	4	5	6	7
I did not plan to follow recommended minimum-impact practices in the backcountry.	1	2	3	4	5	6	7
Early in life I spent time engaged in mechanized recreational activities such as four wheeling, snowmobiling, and/or boating.	1	2	3	4	5	6	7
Other members of my backcountry group would find it acceptable for me to bathe in a stream or lake.	1	2	3	4	5	6	7
Other members of my backcountry party would approve of me moving a few rocks or logs around to make camp more comfortable.	1	2	3	4	5	6	7
I was determined to follow recommended minimum-impact practices during my backcountry trip in Olympic NP.	1	2	3	4	5	6	7



**Section D: Backcountry Behavior and Satisfaction****Page 6 of 10**

This section explores your thoughts regarding backcountry travel as well as how satisfied you were with your backcountry experience in Olympic National Park.

16. Please rate your level of agreement with the following statements using the scale '1' Not at all under my control to '7' Completely under my control.

	Not at all under my control		Neutral			Completely under my control	
	↓			↓			↓
<i>(please circle one number per statement)</i>							
How I act while in the backcountry of Olympic National Park is...	1	2	3	4	5	6	7
The way I act while in the backcountry of Olympic National Park is...	1	2	3	4	5	6	7
My choosing to have a campfire in the backcountry of Olympic National Park is...	1	2	3	4	5	6	7
Walking around muddy areas on the trail while in Olympic National Park is...	1	2	3	4	5	6	7
My backcountry camping practices in Olympic National Park are...	1	2	3	4	5	6	7

17. Please rate how difficult you feel the following actions would be to take while in the backcountry of Olympic National Park using the scale '1' Very difficult to '7' Very easy.

	Very Difficult		Neutral			Very Easy	
	↓			↓			↓
<i>(please circle one number per statement)</i>							
If I wanted to, carrying all of my litter out of the backcountry of Olympic National Park would be:	1	2	3	4	5	6	7
Carrying used toilet paper out of the backcountry of Olympic National Park would be:	1	2	3	4	5	6	7
Depositing my human waste in a small hole in the soil:	1	2	3	4	5	6	7
Walking around a muddy portion of the trail is:	1	2	3	4	5	6	7
I find following Olympic National Park recommended minimum-impact/LNT camping guidelines to be:	1	2	3	4	5	6	7

18. Overall, how satisfied are you with your backcountry trip within Olympic National Park?

*(please circle one number)*

Not at all satisfied	Slightly satisfied	Moderately satisfied	Very satisfied	Extremely satisfied
1	2	3	4	5

**Section E: Backcountry Opinions**
**Page 7 of 10**

19. We would like to know more about your opinion regarding various backcountry practices. Please rate each statement on the 7-point scale using '1' **Very Inappropriate** to '7' **Very Appropriate**. For example, if you feel that "Taking my pet into the backcountry" is a **slightly appropriate** backcountry practice then you would circle #5.

(please circle one number per statement)	Very Inappropriate ↓				Neutral ↓			Very Appropriate ↓
	1	2	3	4	5	6	7	
Camping along the edge a stream or lake.	1	2	3	4	5	6	7	
Moving rocks from where I plan to place my tent.	1	2	3	4	5	6	7	
Burying used toilet paper.	1	2	3	4	5	6	7	
Having a campfire.	1	2	3	4	5	6	7	
Keeping a single small item like a rock or feather as a souvenir.	1	2	3	4	5	6	7	
Cooking over a fire in the backcountry.	1	2	3	4	5	6	7	
Taking a break along the edge of the trail.	1	2	3	4	5	6	7	
Urinating on vegetation.	1	2	3	4	5	6	7	
Moving rocks and/or logs to make a campsite more comfortable.	1	2	3	4	5	6	7	
Burning paper trash in the campfire.	1	2	3	4	5	6	7	
Walking around muddy spots on the trail.	1	2	3	4	5	6	7	
When camping in heavily used areas, placing the tent in an undisturbed spot.	1	2	3	4	5	6	7	
Using soap in streams as long as there are currents to help dilute the suds.	1	2	3	4	5	6	7	
Dropping food on the ground to provide wildlife a food source.	1	2	3	4	5	6	7	
Building a fire ring if one is not present.	1	2	3	4	5	6	7	
Hiking side by side with my friends on existing backcountry trails.	1	2	3	4	5	6	7	
Depositing human waste on top of the ground so it will decompose quickly.	1	2	3	4	5	6	7	
In popular backcountry areas, camping where no one has camped before.	1	2	3	4	5	6	7	
Disposing of dishwater in streams or lakes.	1	2	3	4	5	6	7	
Swimming in streams/lakes.	1	2	3	4	5	6	7	
Camping two nights in a pristine campsite.	1	2	3	4	5	6	7	
Feeding wildlife.	1	2	3	4	5	6	7	
Camping with large groups (8 or more people) in the backcountry.	1	2	3	4	5	6	7	
Leaving charred wood contained in the fire ring.	1	2	3	4	5	6	7	

The NPS and other land management agencies promote various minimum-impact skills and ethics training programs. Please answer the following questions regarding minimum-impact messages.

20. Have you ever heard of minimum-impact backcountry ethics/practices? *(please check one answer)*

☐ No

☐ Yes → I first heard of *minimum-impact practices* in \_\_\_\_\_ (Year)

21. Have you ever heard of *Leave No Trace*? *(please check one answer)*

☐ No (If NO, please skip to Question #25)

☐ Yes → I first heard of *Leave No Trace* in \_\_\_\_\_ (Year)

22. Where or from whom did you **first hear** of *Leave No Trace*? *(please check one answer)*

☐ Family / Friends

☐ Park personnel / Park education talk

☐ Information kiosk / Park literature

☐ Boy/Girl Scouts

☐ Popular media (magazines, books)

☐ Leave No Trace Webpage

☐ Class / Course

☐ Internet in general

☐ Other (please describe) \_\_\_\_\_

23. What has been your **primary source** of *Leave No Trace* information? *(please check one answer)*

☐ Family / Friends

☐ Park personnel / Park education talk

☐ Information kiosk / Park literature

☐ Boy/Girl Scouts

☐ Popular media (magazines, books)

☐ Leave No Trace Webpage

☐ Class / Course

☐ Internet in general

☐ Other (please describe) \_\_\_\_\_

24. Please rate your level of agreement with the following statements using the scale '1' Strongly Disagree to '7' Strongly Agree.

	Strongly Disagree		Neutral		Strongly Agree	
<i>(please circle one number per statement)</i>	↓		↓		↓	
Minimum-impact/LNT techniques do not reduce the environmental harm caused by backcountry travel.	1	2	3	4	5	6 7
It is important to use minimum-impact/LNT techniques when in the backcountry.	1	2	3	4	5	6 7
If I learned my actions in the backcountry damaged the environment I would change my behavior.	1	2	3	4	5	6 7
I get upset when I see other individuals in the backcountry not following minimum-impact/LNT practices.	1	2	3	4	5	6 7
I insist that minimum-impact/LNT practices are followed by all members of my backcountry party.	1	2	3	4	5	6 7

25. Did you do any of the following before your recent trip?:
- Using a scale of '0' (nothing) to '6' (an extensive amount), how much did you learn about minimum-impact/LNT from this experience?

	Please circle one			Nothing							Extensive Amount
	No	Yes	If yes ->	0	1	2	3	4	5	6	
Speak with a ranger regarding minimum-impact/LNT practices?											
Watch a video regarding minimum-impact/LNT practices?											
Review any printed park literature regarding minimum-impact/LNT practices?											
Visit the Olympic National Park website to learn about minimum-impact/LNT practices?											

26. How would you describe your current knowledge of Leave No Trace practices?  
(please circle one number)

No knowledge      Very Limited      Limited      Average      Above Average      Extensive      Expert  
 0                      1                      2                      3                      4                      5                      6

27. Did you do any of the following before your recent trip?:

(please circle one number per statement)

	No	Yes
Spend time on the internet researching the trip?	1	2
Check with Olympic National Park regarding backcountry regulations?	1	2
Carry a topographic map and a compass?	1	2
Check with Olympic National Park regarding trail closures before arriving at the park?	1	2



To finish this study we need a profile of our study population to make sure it is representative of typical backcountry visitors to Olympic National Park. None of the information in this or other sections will be associated with your name.

28. What is your sex? *(please check one answer)*

☐ Male ☐ Female

29. What is your age? \_\_\_\_\_ YEARS

30. Please provide the zip code of your primary residence or country of residence if not USA:

\_\_\_\_\_

31. Which of the following represents your race or ethnic background? *(please check one answer)*

☐ White, not of Hispanic descent      ☐ Asian or Pacific Islander  
☐ Black, not of Hispanic descent      ☐ American Indian or Pacific Islander  
☐ Hispanic      ☐ Do not wish to answer

32. What is the highest education level you have attained? *(please circle one number)*

Elementary	High School	College	Graduate Study
5 6 7 8	9 10 11 12	13 14 15 16	17 18 19 20+

33. Which of the following income levels best describes your total household income, before taxes (2006)? *(please check one answer)*

☐ Less than \$20,000      ☐ \$60,000 - \$79,999  
☐ \$20,000 - \$39,999      ☐ \$80,000 - \$99,999  
☐ \$40,000 - \$59,999      ☐ \$100,000 or more

34. Did you experience any emergencies or severe weather (snow, heavy rain, ice, etc.) during your trip in the backcountry of Olympic National Park?

☐ No

☐ Yes → If YES, did this situation force you to do anything you normally would not?

☐ No

☐ Yes *(please describe)* \_\_\_\_\_

35. Finally, did you camp primarily:

☐ at the beach

☐ in the mountains

## Concluding Comments

Is there anything else you would like to tell us about backcountry camping or Leave No Trace in Olympic National Park? Please include any additional thoughts or comments you may have below.

**Thank you for your participation in this important study!**

Please return your completed questionnaire in the pre-paid reply envelope provided as soon as possible so we can remove your name from our mailing list.

This form should be returned in the enclosed self-addressed stamped envelope to:

**Department of Parks, Recreation, and Tourism Management  
PO BOX  
Clemson University  
Clemson, South Carolina 29631-**

**PRIVACY ACT and PAPERWORK REDUCTION ACT statement:**

16 U.S.C. 1a-7 authorizes collection of this information. This information will be used by park managers to better serve the public. Response to this request is voluntary. No action may be taken against you for refusing to supply the information requested. Your name is requested for follow-up mailing purposes only. When analysis of the questionnaire is completed, all name and address files will be destroyed. Thus permanent data will be anonymous. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Burden estimate statement: Public reporting for this form is estimated to average **15** minutes per response. Direct comments regarding the burden estimate or any other aspect of this form to:

Rick Potts, 1201 Eye (I) Street, 10<sup>th</sup> Floor Room 1047, Washington D.C., 20005; Rick\_Potts@nps.gov

## REMINDER POSTCARD

Dear Olympic National Park Backcountry Visitor –

Recently we sent you a questionnaire. If you filled it out, thank you. If not, this card is a friendly reminder and appeal to ask that you please fill out and return the Olympic National Park Backcountry Visitor Study.

Your response is very valuable to the success of this study and we hope you will take the time to participate. If you misplaced the survey and would like another copy please email me at [wadev@clemson.edu](mailto:wadev@clemson.edu) or call (724) 355 – 0985. I hope to hear from you soon.

All the best,

Wade Vagias  
Olympic National Park and Clemson University

## COVER LETTER – 2<sup>ND</sup> MAILING

Dear Olympic National Park Backcountry Visitor,

Several weeks ago, we sent you a questionnaire. To the best of our knowledge, you have not yet responded. If you completed and mailed your questionnaire within the last few days, thank you. Otherwise, this letter is an appeal to ask that you please fill out and return the enclosed questionnaire, which will provide useful information to Olympic National Park for improving visitor experiences within the backcountry of the park.

Your responses to this survey are very important because you are one of a select group of people who were chosen to represent the attitudes and opinions of Olympic National Park backcountry travelers. We recognize that your time is valuable, but we hope that you will agree to take part in this voluntary survey. Your responses will be only reported in broad statistical terms. We are very interested in your answers, so please try to answer every question. The ID number located on the back of the questionnaire is for mailing purposes only.

Finally, we hope you find the enclosed survey interesting to fill out. When you have completed the survey, please place it in the postage paid envelope and drop it in any mailbox. If you have any questions regarding the survey or would like information on the studies' results, please contact me at [wadev@clermson.edu](mailto:wadev@clermson.edu) or at 724/355-0985.

Thank you very much for your help with this valuable study.

Sincerely,

Wade Vagias  
Olympic National Park &  
Clemson University, Department of Parks, Recreation, and Tourism Management

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